Analise exploratória.

Introdução.

Este Jupyter Notebook investiga a base de dados de propriedades acústicas disponíveis no site http://www.primaryobjects.com/2016/06/22/identifying-the-gender-of-a-voice-using-machine-learning/ (http://www.primaryobjects.com/2016/06/22/identifying-the-gender-of-a-voice-using-machine-learning/) Objetivo da investigação é determinar as chances de algum algoritmo para detecção de gênero, seja por estatística tradicional ou por meio técnicas machine learning e redes neurais, possibilitando a implantação em dispositivos embarcados de baixo custo de memória e processamento restrito.

Propriedades acústicas medidas

As seguintes propriedades acústicas de cada voz são medidas:

- **meanfreq** : frequência média (em kHz) sobre as amostras compostas no sinal de arquivo de voz;
- **sd** : desvio padrão da frequência, sobre as amostras compostas no sinal de arquivo de voz;
- **mediana** : frequência mediana (em kHz) sobre as amostras compostas no sinal de arquivo de voz;
- **Q25** : primeiro quantil (em kHz) sobre as amostras compostas no sinal de arquivo de voz;
- **Q75** : terceiro quantil (em kHz) sobre as amostras compostas no sinal de arquivo de voz;
- **IQR** : intervalo interquartil (em kHz)sobre as amostras compostas no sinal de arquivo de voz;
- **skew** : média de assimetria da distribuição das frequências de vocal perdominante;
- **kurt** : curtose distribuição espectral da voz, domínio da frequência;
- **sp.ent** : entropia espectral, pureza da distribuição da voz em relação ao nível de ruído;
- **sfm** : nivelamento espectral, estima a planaridade de um espectro de frequência;
- **modo** : frequência de modo, ou seja, frequência dominante da voz;
- **centrod** : frequência central máxima visto no domínio da frequência;
- **meanfun** : média da frequência fundamental medida através do sinal acústico (Tonalidade base da voz);
- **minfun** : frequência fundamental mínima medida no sinal acústico (Tonalidade base da voz);
- **maxfun** : frequência fundamental máxima medida através do sinal acústico (Tonalidade base da voz);
- **meandom** : média da frequência dominante medida através do sinal acústico (média total das notas musicais mais graves da voz em relação ao sinal gravado);
- **mindom** : mínimo de frequência dominante medido através do sinal acústico;
- **maxdom** : máxima da frequência dominante medida através do sinal acústico;
- **dfrange** : faixa de frequência dominante medida através do sinal acústico;
- **modindx** : índice de modulação. Calculado como a diferença absoluta acumulada entre medições adjacentes de frequências fundamentais divididas pela faixa de frequência.
- **label** : rotulo de identificador da amostra em relação ao sexo, adicionado durante a gravação "male" ou "female".

Analise em python da base de propriedades acústicas.

In [1]:

```
%matplotlib inline
```

In [2]:

```
# Importa as bibliotecas
import pandas
import matplotlib.pyplot as plt
import numpy
#from pandas.tools.plotting import scatter_matrix
from  pandas.plotting  import scatter_matrix
import seaborn as sb
```

In [3]:

```
# Carrega os dados
url = ".\\baseDados\\voice.csv"
colunas = ["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","sfm","mod
e","centroid","meanfun","minfun","maxfun","meandom","mindom","maxdom","dfrange","modind
x","label"]
dataset = pandas.read_csv(url, names=colunas, sep = ",")
```

In [4]:

```
# PANDAS: Verificando alguns dados
exemplos = dataset.head(2)
print(exemplos)
```

```
   meanfreq        sd    median       Q25       Q75       IQR       skew
\
0  0.059781  0.064241  0.032027  0.015071  0.090193  0.075122  12.863462
1  0.066009  0.067310  0.040229  0.019414  0.092666  0.073252  22.423285

         kurt    sp.ent       sfm  ...    centroid   meanfun    minfun
\
0  274.402906  0.893369  0.491918  ...    0.059781  0.084279  0.015702
1  634.613855  0.892193  0.513724  ...    0.066009  0.107937  0.015826

     maxfun   meandom    mindom    maxdom   dfrange   modindx  label
0  0.275862  0.007812  0.007812  0.007812  0.000000  0.000000   male
1  0.250000  0.009014  0.007812  0.054688  0.046875  0.052632   male

[2 rows x 21 columns]
```

In [5]:

```
dataset.head()
```

Out[5]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt	s
0	0.059781	0.064241	0.032027	0.015071	0.090193	0.075122	12.863462	274.402906	0.89
1	0.066009	0.067310	0.040229	0.019414	0.092666	0.073252	22.423285	634.613855	0.89
2	0.077316	0.083829	0.036718	0.008701	0.131908	0.123207	30.757155	1024.927705	0.84
3	0.151228	0.072111	0.158011	0.096582	0.207955	0.111374	1.232831	4.177296	0.96
4	0.135120	0.079146	0.124656	0.078720	0.206045	0.127325	1.101174	4.333713	0.97

5 rows × 21 columns

In [6]:

```
dataset.tail()
exemplos = dataset.tail(2)
print(exemplos)
```

```
      meanfreq        sd    median       Q25       Q75       IQR       sk
ew  \
3166  0.143659  0.090628  0.184976  0.043508  0.219943  0.176435  1.5910
65
3167  0.165509  0.092884  0.183044  0.070072  0.250827  0.180756  1.7050
29

          kurt    sp.ent       sfm   ...    centroid   meanfun    minfun
\
3166  5.388298  0.950436  0.675470   ...    0.143659  0.172375  0.034483
3167  5.769115  0.938829  0.601529   ...    0.165509  0.185607  0.062257

        maxfun   meandom    mindom    maxdom   dfrange   modindx   label
3166  0.250000  0.791360  0.007812  3.593750  3.585938  0.311002  female
3167  0.271186  0.227022  0.007812  0.554688  0.546875  0.350000  female

[2 rows x 21 columns]
```

Verifica valores nulos.

In [7]:

```
dfnull = dataset.isnull()
```

In [8]:

```
dfnull.head(3)
```

Out[8]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt	sp.ent	sfm	...	centroid	m
0	False	False	False	False	False	False	False	False	False	False	...	False	
1	False	False	False	False	False	False	False	False	False	False	...	False	
2	False	False	False	False	False	False	False	False	False	False	...	False	

3 rows × 21 columns

In [9]:

```
dfnull.isnull().sum()
```

Out[9]:

```
meanfreq    0
sd          0
median      0
Q25         0
Q75         0
IQR         0
skew        0
kurt        0
sp.ent      0
sfm         0
mode        0
centroid    0
meanfun     0
minfun      0
maxfun      0
meandom     0
mindom      0
maxdom      0
dfrange     0
modindx     0
label       0
dtype: int64
```

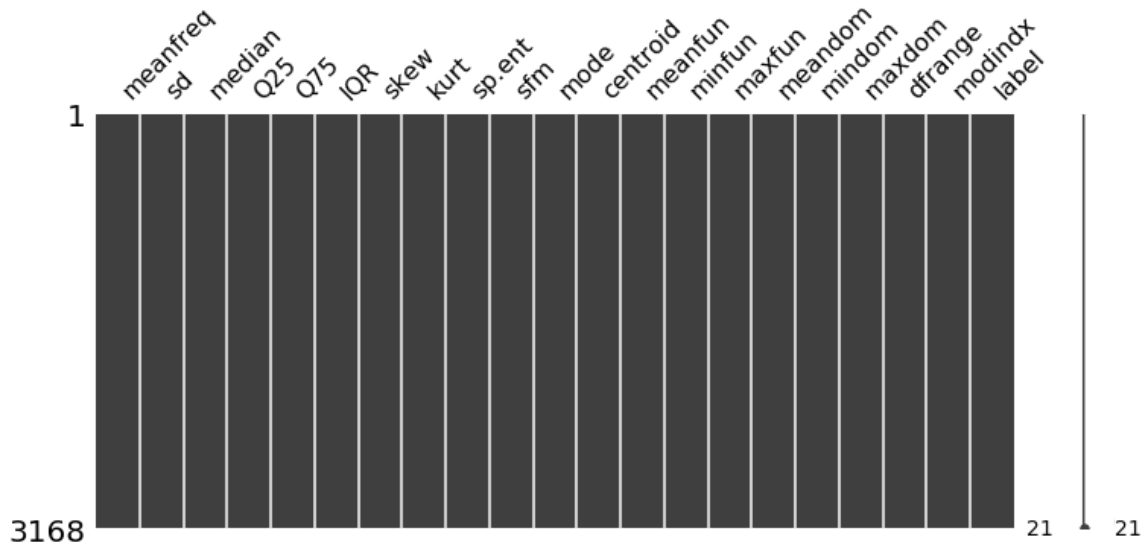
Gerando gráfico com valores nulos.

In [10]:

```
#!pip install missingno
#!pip3 install missingno


import missingno as msno
msno.matrix(dataset,figsize=(12,5))
```

Out[10]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x13a93730>
```



Compara a dimensão da tabela original com nova tabela onde foi removidos os elementos nulos.

In [11]:

```
dfnull.dropna()
print(dfnull.shape)
```

```
(3168, 21)
```

In [12]:

```
# PANDAS: Verifica a dimensão dos dados (linhas, colunas)
dim = dataset.shape
print(dim)
```

```
(3168, 21)
```

Tabela sem elementos nulos tem a mesma dimenssão da tabela original, portanto a base não possui valores nulos.

Verifica os tipos de dados de cada atributo

In [13]:

```
dataset.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 3168 entries, 0 to 3167
Data columns (total 21 columns):
meanfreq    3168 non-null float64
sd          3168 non-null float64
median      3168 non-null float64
Q25         3168 non-null float64
Q75         3168 non-null float64
IQR         3168 non-null float64
skew        3168 non-null float64
kurt        3168 non-null float64
sp.ent      3168 non-null float64
sfm         3168 non-null float64
mode        3168 non-null float64
centroid    3168 non-null float64
meanfun     3168 non-null float64
minfun      3168 non-null float64
maxfun      3168 non-null float64
meandom     3168 non-null float64
mindom      3168 non-null float64
maxdom      3168 non-null float64
dfrange     3168 non-null float64
modindx     3168 non-null float64
label       3168 non-null object
dtypes: float64(20), object(1)
memory usage: 507.4+ KB
```

PANDAS: Verifica os tipos de dados de cada atributo.

In [14]:

```
tipos = dataset.dtypes
print(tipos)
```

```
meanfreq    float64
sd          float64
median      float64
Q25         float64
Q75         float64
IQR         float64
skew        float64
kurt        float64
sp.ent      float64
sfm         float64
mode        float64
centroid    float64
meanfun     float64
minfun      float64
maxfun      float64
meandom     float64
mindom      float64
maxdom      float64
dfrange     float64
modindx     float64
label        object
dtype: object
```

Estatística descritiva

In [15]:

```
dataset.describe()
```

Out[15]:

	meanfreq	sd	median	Q25	Q75	IQR	
count	3168.000000	3168.000000	3168.000000	3168.000000	3168.000000	3168.000000	3168.(
mean	0.180907	0.057126	0.185621	0.140456	0.224765	0.084309	3.1
std	0.029918	0.016652	0.036360	0.048680	0.023639	0.042783	4.2
min	0.039363	0.018363	0.010975	0.000229	0.042946	0.014558	0.1
25%	0.163662	0.041954	0.169593	0.111087	0.208747	0.042560	1.(
50%	0.184838	0.059155	0.190032	0.140286	0.225684	0.094280	2.1
75%	0.199146	0.067020	0.210618	0.175939	0.243660	0.114175	2.9
max	0.251124	0.115273	0.261224	0.247347	0.273469	0.252225	34.7

Pandas: Estatística descritiva

In [16]:

```
pandas.set_option('display.width', 100)
pandas.set_option('precision', 3)
resultado = dataset.describe()
print(resultado)
```

```
       meanfreq        sd    median        Q25       Q75       IQR       sk
ew      kurt    sp.ent  \
count  3168.000  3168.000  3168.000  3.168e+03  3168.000  3168.000  3168.0
00  3168.000  3168.000
mean      0.181     0.057     0.186  1.405e-01     0.225     0.084     3.1
40    36.568     0.895
std       0.030     0.017     0.036  4.868e-02     0.024     0.043     4.2
41   134.929     0.045
min       0.039     0.018     0.011  2.288e-04     0.043     0.015     0.1
42     2.068     0.739
25%       0.164     0.042     0.170  1.111e-01     0.209     0.043     1.6
50     5.670     0.862
50%       0.185     0.059     0.190  1.403e-01     0.226     0.094     2.1
97     8.318     0.902
75%       0.199     0.067     0.211  1.759e-01     0.244     0.114     2.9
32    13.649     0.929
max       0.251     0.115     0.261  2.473e-01     0.273     0.252    34.7
25  1309.613     0.982

            sfm      mode  centroid   meanfun    minfun    maxfun   meando
m    mindom    maxdom  \
count  3168.000  3168.000  3168.000  3168.000  3168.000  3168.000  3168.00
0  3168.000  3168.000
mean      0.408     0.165     0.181     0.143     0.037     0.259     0.82
9     0.053     5.047
std       0.178     0.077     0.030     0.032     0.019     0.030     0.52
5     0.063     3.521
min       0.037     0.000     0.039     0.056     0.010     0.103     0.00
8     0.005     0.008
25%       0.258     0.118     0.164     0.117     0.018     0.254     0.42
0     0.008     2.070
50%       0.396     0.187     0.185     0.141     0.046     0.271     0.76
6     0.023     4.992
75%       0.534     0.221     0.199     0.170     0.048     0.277     1.17
7     0.070     7.008
max       0.843     0.280     0.251     0.238     0.204     0.279     2.95
8     0.459    21.867

        dfrange   modindx
count  3168.000  3168.000
mean      4.995     0.174
std       3.520     0.119
min       0.000     0.000
25%       2.045     0.100
50%       4.945     0.139
75%       6.992     0.209
max      21.844     0.932
```

In [17]:

```
dataset.describe().transpose()
```

Out[17]:

	count	mean	std	min	25%	50%	75%	max
meanfreq	3168.0	0.181	0.030	3.936e-02	0.164	0.185	0.199	0.251
sd	3168.0	0.057	0.017	1.836e-02	0.042	0.059	0.067	0.115
median	3168.0	0.186	0.036	1.097e-02	0.170	0.190	0.211	0.261
Q25	3168.0	0.140	0.049	2.288e-04	0.111	0.140	0.176	0.247
Q75	3168.0	0.225	0.024	4.295e-02	0.209	0.226	0.244	0.273
IQR	3168.0	0.084	0.043	1.456e-02	0.043	0.094	0.114	0.252
skew	3168.0	3.140	4.241	1.417e-01	1.650	2.197	2.932	34.725
kurt	3168.0	36.568	134.929	2.068e+00	5.670	8.318	13.649	1309.613
sp.ent	3168.0	0.895	0.045	7.387e-01	0.862	0.902	0.929	0.982
sfm	3168.0	0.408	0.178	3.688e-02	0.258	0.396	0.534	0.843
mode	3168.0	0.165	0.077	0.000e+00	0.118	0.187	0.221	0.280
centroid	3168.0	0.181	0.030	3.936e-02	0.164	0.185	0.199	0.251
meanfun	3168.0	0.143	0.032	5.557e-02	0.117	0.141	0.170	0.238
minfun	3168.0	0.037	0.019	9.775e-03	0.018	0.046	0.048	0.204
maxfun	3168.0	0.259	0.030	1.031e-01	0.254	0.271	0.277	0.279
meandom	3168.0	0.829	0.525	7.812e-03	0.420	0.766	1.177	2.958
mindom	3168.0	0.053	0.063	4.883e-03	0.008	0.023	0.070	0.459
maxdom	3168.0	5.047	3.521	7.812e-03	2.070	4.992	7.008	21.867
dfrange	3168.0	4.995	3.520	0.000e+00	2.045	4.945	6.992	21.844
modindx	3168.0	0.174	0.119	0.000e+00	0.100	0.139	0.209	0.932

In [18]:

```
print(dataset.describe().transpose())
```

```
           count    mean      std        min    25%    50%     75%       m
ax
meanfreq  3168.0   0.181    0.030  3.936e-02  0.164  0.185   0.199     0.2
51
sd        3168.0   0.057    0.017  1.836e-02  0.042  0.059   0.067     0.1
15
median    3168.0   0.186    0.036  1.097e-02  0.170  0.190   0.211     0.2
61
Q25       3168.0   0.140    0.049  2.288e-04  0.111  0.140   0.176     0.2
47
Q75       3168.0   0.225    0.024  4.295e-02  0.209  0.226   0.244     0.2
73
IQR       3168.0   0.084    0.043  1.456e-02  0.043  0.094   0.114     0.2
52
skew      3168.0   3.140    4.241  1.417e-01  1.650  2.197   2.932    34.7
25
kurt      3168.0  36.568  134.929  2.068e+00  5.670  8.318  13.649  1309.6
13
sp.ent    3168.0   0.895    0.045  7.387e-01  0.862  0.902   0.929     0.9
82
sfm       3168.0   0.408    0.178  3.688e-02  0.258  0.396   0.534     0.8
43
mode      3168.0   0.165    0.077  0.000e+00  0.118  0.187   0.221     0.2
80
centroid  3168.0   0.181    0.030  3.936e-02  0.164  0.185   0.199     0.2
51
meanfun   3168.0   0.143    0.032  5.557e-02  0.117  0.141   0.170     0.2
38
minfun    3168.0   0.037    0.019  9.775e-03  0.018  0.046   0.048     0.2
04
maxfun    3168.0   0.259    0.030  1.031e-01  0.254  0.271   0.277     0.2
79
meandom   3168.0   0.829    0.525  7.812e-03  0.420  0.766   1.177     2.9
58
mindom    3168.0   0.053    0.063  4.883e-03  0.008  0.023   0.070     0.4
59
maxdom    3168.0   5.047    3.521  7.812e-03  2.070  4.992   7.008    21.8
67
dfrange   3168.0   4.995    3.520  0.000e+00  2.045  4.945   6.992    21.8
44
modindx   3168.0   0.174    0.119  0.000e+00  0.100  0.139   0.209     0.9
32
```

Variáveis Categóricas

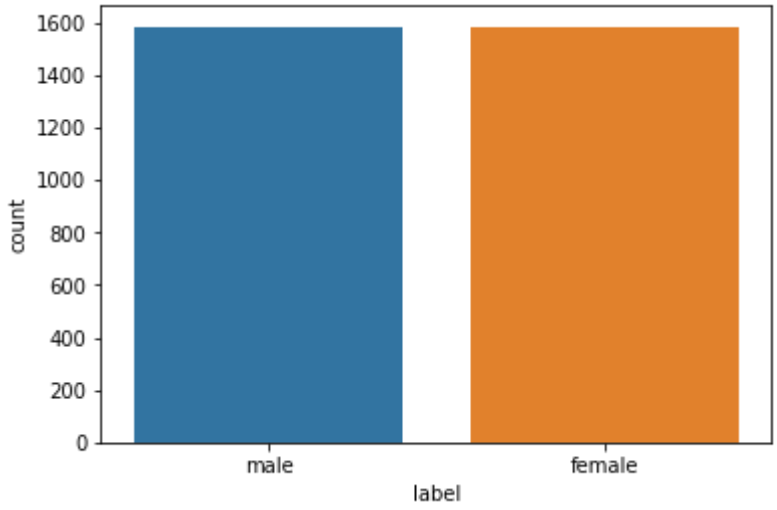
In [19]:

```
contagem = dataset.groupby('label').size()
print(contagem)
```

```
label
female    1584
male      1584
dtype: int64
```

In [20]:

```
sb.countplot('label',data=dataset)
plt.rcParams['figure.figsize'] = (10,5)
plt.show()
```



Em nossos dados exitem apenas um variável *label* que é Qualitativa Nominal sendo que demais são do tipo Quantitativa Contínua

In [21]:

```
dataset.dtypes
A = str(tipos)
A = A.replace('float64',"Qualitativa Nominal")
A = A.replace('object',"Quantitativa Contínua")

print(A)
```

```
meanfreq    Qualitativa Nominal
sd          Qualitativa Nominal
median      Qualitativa Nominal
Q25         Qualitativa Nominal
Q75         Qualitativa Nominal
IQR         Qualitativa Nominal
skew        Qualitativa Nominal
kurt        Qualitativa Nominal
sp.ent      Qualitativa Nominal
sfm         Qualitativa Nominal
mode        Qualitativa Nominal
centroid    Qualitativa Nominal
meanfun     Qualitativa Nominal
minfun      Qualitativa Nominal
maxfun      Qualitativa Nominal
meandom     Qualitativa Nominal
mindom      Qualitativa Nominal
maxdom      Qualitativa Nominal
dfrange     Qualitativa Nominal
modindx     Qualitativa Nominal
label        Quantitativa Contínua
dtype: Quantitativa Contínua
```

Medidas Resumo Variáveis Quantitativas:

MEDIDAS DE POSIÇÃO: Moda, Média, Mediana, Percentís, Quartis.

Voltado na tabela temos:

MEDIDAS DE POSIÇÃO, já estão calculados na tabelas describe Media , Percentís, Quartis

Faltando calcular a Moda e Mediana sabendo a Mediana e a mesma medias Na colunaE o valor da coluna 50% da tabela.

A média é uma medida de tendência central que indica o valor onde estão concentrados os dados de um conjunto de valores, representando um valor significativo para o mesmo.

A mediana é o valor que separa a metade superior da metade inferior de uma distribuição de dados, ou o valor no centro da distribuição.

A moda é simples. Nada mais é que o valor que mais se repete dentro de um conjunto.

In [22]:

```
dataset.describe().transpose()
```

Out[22]:

	count	mean	std	min	25%	50%	75%	max
meanfreq	3168.0	0.181	0.030	3.936e-02	0.164	0.185	0.199	0.251
sd	3168.0	0.057	0.017	1.836e-02	0.042	0.059	0.067	0.115
median	3168.0	0.186	0.036	1.097e-02	0.170	0.190	0.211	0.261
Q25	3168.0	0.140	0.049	2.288e-04	0.111	0.140	0.176	0.247
Q75	3168.0	0.225	0.024	4.295e-02	0.209	0.226	0.244	0.273
IQR	3168.0	0.084	0.043	1.456e-02	0.043	0.094	0.114	0.252
skew	3168.0	3.140	4.241	1.417e-01	1.650	2.197	2.932	34.725
kurt	3168.0	36.568	134.929	2.068e+00	5.670	8.318	13.649	1309.613
sp.ent	3168.0	0.895	0.045	7.387e-01	0.862	0.902	0.929	0.982
sfm	3168.0	0.408	0.178	3.688e-02	0.258	0.396	0.534	0.843
mode	3168.0	0.165	0.077	0.000e+00	0.118	0.187	0.221	0.280
centroid	3168.0	0.181	0.030	3.936e-02	0.164	0.185	0.199	0.251
meanfun	3168.0	0.143	0.032	5.557e-02	0.117	0.141	0.170	0.238
minfun	3168.0	0.037	0.019	9.775e-03	0.018	0.046	0.048	0.204
maxfun	3168.0	0.259	0.030	1.031e-01	0.254	0.271	0.277	0.279
meandom	3168.0	0.829	0.525	7.812e-03	0.420	0.766	1.177	2.958
mindom	3168.0	0.053	0.063	4.883e-03	0.008	0.023	0.070	0.459
maxdom	3168.0	5.047	3.521	7.812e-03	2.070	4.992	7.008	21.867
dfrange	3168.0	4.995	3.520	0.000e+00	2.045	4.945	6.992	21.844
modindx	3168.0	0.174	0.119	0.000e+00	0.100	0.139	0.209	0.932

Vamos calcular Moda e Mediana que faltam na tabela.

Moda

In [23]:

```
Modadic = {}
Medianaadic = {}
for x in colunas:
    if x == "label":
        continue
    Modadic[x]=dataset[x].mode()[0]
    Medianaadic[x]=dataset[x].median()
```

Calculado a moda e mediana e colocando em dicionário.

In [24]:

```
print(Modadic)
```

```
{'meanfreq': 0.212189914901046, 'sd': 0.0431904308902847, 'median': 0.1866
6666666666698, 'Q25': 0.14, 'Q75': 0.24, 'IQR': 0.035, 'skew': 1.862572808
5862199, 'kurt': 6.10979028593433, 'sp.ent': 0.8597123484255591, 'sfm': 0.
0849343635514977, 'mode': 0.0, 'centroid': 0.212189914901046, 'meanfun':
0.133667302572349, 'minfun': 0.0469208211143695, 'maxfun': 0.2790697674418
6, 'meandom': 0.0078125, 'mindom': 0.0234375, 'maxdom': 0.0078125, 'dfrang
e': 0.0, 'modindx': 0.0}
```

In [25]:

```
print(Medianaadic)
```

```
{'meanfreq': 0.18483840942471752, 'sd': 0.05915511912795825, 'median': 0.1
9003237922971, 'Q25': 0.1402864183481785, 'Q75': 0.22568421491103252, 'IQ
R': 0.09427995391705071, 'skew': 2.197100657225325, 'kurt': 8.318463288598
01, 'sp.ent': 0.9017668303293546, 'sfm': 0.396335156832049, 'mode': 0.1865
9863945578248, 'centroid': 0.18483840942471752, 'meanfun': 0.1405185180281
2348, 'minfun': 0.0461095100864553, 'maxfun': 0.271186440677966, 'meando
m': 0.7657948369565215, 'mindom': 0.0234375, 'maxdom': 4.9921875, 'dfrang
e': 4.9453125, 'modindx': 0.13935702262536853}
```

Transformando os resultados em data frame.

In [26]:

```
dfModa = pandas.DataFrame.from_dict(Modadic, orient="index").reset_index()
dfModa.columns = ["quantitativas","moda"]
dfModa.head()
```

Out[26]:

	quantitativas	moda
0	meanfreq	0.212
1	sd	0.043
2	median	0.187
3	Q25	0.140
4	Q75	0.240

In [27]:

```
dfmediana = pandas.DataFrame.from_dict(Medianaadic, orient="index").reset_index()
dfmediana.columns = ["quantitativas","mediana"]
dfmediana.head()
```

Out[27]:

	quantitativas	mediana
0	meanfreq	0.185
1	sd	0.059
2	median	0.190
3	Q25	0.140
4	Q75	0.226

In [28]:

```
### usado para unir os dataframes.
df50porcento = pandas.DataFrame.from_dict(Medianaadic, orient="index").reset_index()
df50porcento.columns = ["quantitativas","50%"]
df50porcento.head()
```

Out[28]:

	quantitativas	50%
0	meanfreq	0.185
1	sd	0.059
2	median	0.190
3	Q25	0.140
4	Q75	0.226

Montado em um único data frame.

In [29]:

```
dfmediaModa=pandas.merge(dfModa,dfmediana,how='left',on='quantitativas')
dfmediaModa=pandas.merge(dfmediaModa,df50porcento,how='left',on='quantitativas')
```

In [30]:

```
print(dfmediaModa)
```

```
   quantitativas   moda  mediana    50%
0       meanfreq  0.212    0.185  0.185
1             sd  0.043    0.059  0.059
2         median  0.187    0.190  0.190
3            Q25  0.140    0.140  0.140
4            Q75  0.240    0.226  0.226
5            IQR  0.035    0.094  0.094
6           skew  1.863    2.197  2.197
7           kurt  6.110    8.318  8.318
8         sp.ent  0.860    0.902  0.902
9            sfm  0.085    0.396  0.396
10          mode  0.000    0.187  0.187
11      centroid  0.212    0.185  0.185
12       meanfun  0.134    0.141  0.141
13        minfun  0.047    0.046  0.046
14        maxfun  0.279    0.271  0.271
15       meandom  0.008    0.766  0.766
16        mindom  0.023    0.023  0.023
17        maxdom  0.008    4.992  4.992
18       dfrange  0.000    4.945  4.945
19       modindx  0.000    0.139  0.139
```

MEDIDAS DE DISPERSÃO: Amplitude, Intervalo-Interquartil, Variância, Desvio Padrão, Coeficiente de Variação.

Finalidade: encontrar um valor que resuma a variabilidade de um conjunto de dados

A amplitude nada mais é do que a diferença entre o maior e o menor valor de um conjunto de dados. A variância é uma medida que expressa quanto os dados de um conjunto estão afastados de seu valor esperado. O desvio padrão também é uma medida de dispersão, que indica quanto os dados estão afastados da média.

O coeficiente de varição é usado para expressar a variabilidade dos dados estatísticos excluindo a influência da ordem de grandeza da variável.

Montar a tabela com todos dados estatísticos até agora.

In [31]:

```
dados_estatisticos = dataset.describe().transpose()
dados_estatisticos=pandas.merge(dfmediaModa,dados_estatisticos,how='right',on='50%')
print(dados_estatisticos)
dados_estatisticos
```

	quantitativas	moda	mediana	50%	count	mean	std	mi	n	25%	75%	\
0	meanfreq	0.212	0.185	0.185	3168.0	0.181	0.030	3.936e-0	2	0.164	0.199	
1	centroid	0.212	0.185	0.185	3168.0	0.181	0.030	3.936e-0	2	0.164	0.199	
2	meanfreq	0.212	0.185	0.185	3168.0	0.181	0.030	3.936e-0	2	0.164	0.199	
3	centroid	0.212	0.185	0.185	3168.0	0.181	0.030	3.936e-0	2	0.164	0.199	
4	sd	0.043	0.059	0.059	3168.0	0.057	0.017	1.836e-0	2	0.042	0.067	
5	median	0.187	0.190	0.190	3168.0	0.186	0.036	1.097e-0	2	0.170	0.211	
6	Q25	0.140	0.140	0.140	3168.0	0.140	0.049	2.288e-0	4	0.111	0.176	
7	Q75	0.240	0.226	0.226	3168.0	0.225	0.024	4.295e-0	2	0.209	0.244	
8	IQR	0.035	0.094	0.094	3168.0	0.084	0.043	1.456e-0	2	0.043	0.114	
9	skew	1.863	2.197	2.197	3168.0	3.140	4.241	1.417e-0	1	1.650	2.932	
10	kurt	6.110	8.318	8.318	3168.0	36.568	134.929	2.068e+0	0	5.670	13.649	
11	sp.ent	0.860	0.902	0.902	3168.0	0.895	0.045	7.387e-0	1	0.862	0.929	
12	sfm	0.085	0.396	0.396	3168.0	0.408	0.178	3.688e-0	2	0.258	0.534	
13	mode	0.000	0.187	0.187	3168.0	0.165	0.077	0.000e+0	0	0.118	0.221	
14	meanfun	0.134	0.141	0.141	3168.0	0.143	0.032	5.557e-0	2	0.117	0.170	
15	minfun	0.047	0.046	0.046	3168.0	0.037	0.019	9.775e-0	3	0.018	0.048	
16	maxfun	0.279	0.271	0.271	3168.0	0.259	0.030	1.031e-0	1	0.254	0.277	
17	meandom	0.008	0.766	0.766	3168.0	0.829	0.525	7.812e-0	3	0.420	1.177	
18	mindom	0.023	0.023	0.023	3168.0	0.053	0.063	4.883e-0	3	0.008	0.070	
19	maxdom	0.008	4.992	4.992	3168.0	5.047	3.521	7.812e-0	3	2.070	7.008	
20	dfrange	0.000	4.945	4.945	3168.0	4.995	3.520	0.000e+0	0	2.045	6.992	
21	modindx	0.000	0.139	0.139	3168.0	0.174	0.119	0.000e+0	0	0.100	0.209	

	max
0	0.251
1	0.251
2	0.251
3	0.251
4	0.115
5	0.261
6	0.247
7	0.273
8	0.252
9	34.725
10	1309.613
11	0.982
12	0.843

```
13     0.280
14     0.238
15     0.204
16     0.279
17     2.958
18     0.459
19    21.867
20    21.844
21     0.932
```

Out[31]:

	quantitativas	moda	mediana	50%	count	mean	std	min	25%	75%
0	meanfreq	0.212	0.185	0.185	3168.0	0.181	0.030	3.936e-02	0.164	0.199
1	centroid	0.212	0.185	0.185	3168.0	0.181	0.030	3.936e-02	0.164	0.199
2	meanfreq	0.212	0.185	0.185	3168.0	0.181	0.030	3.936e-02	0.164	0.199
3	centroid	0.212	0.185	0.185	3168.0	0.181	0.030	3.936e-02	0.164	0.199
4	sd	0.043	0.059	0.059	3168.0	0.057	0.017	1.836e-02	0.042	0.067
5	median	0.187	0.190	0.190	3168.0	0.186	0.036	1.097e-02	0.170	0.211
6	Q25	0.140	0.140	0.140	3168.0	0.140	0.049	2.288e-04	0.111	0.176
7	Q75	0.240	0.226	0.226	3168.0	0.225	0.024	4.295e-02	0.209	0.244
8	IQR	0.035	0.094	0.094	3168.0	0.084	0.043	1.456e-02	0.043	0.114
9	skew	1.863	2.197	2.197	3168.0	3.140	4.241	1.417e-01	1.650	2.932
10	kurt	6.110	8.318	8.318	3168.0	36.568	134.929	2.068e+00	5.670	13.649
11	sp.ent	0.860	0.902	0.902	3168.0	0.895	0.045	7.387e-01	0.862	0.929
12	sfm	0.085	0.396	0.396	3168.0	0.408	0.178	3.688e-02	0.258	0.534
13	mode	0.000	0.187	0.187	3168.0	0.165	0.077	0.000e+00	0.118	0.221
14	meanfun	0.134	0.141	0.141	3168.0	0.143	0.032	5.557e-02	0.117	0.170
15	minfun	0.047	0.046	0.046	3168.0	0.037	0.019	9.775e-03	0.018	0.048
16	maxfun	0.279	0.271	0.271	3168.0	0.259	0.030	1.031e-01	0.254	0.277
17	meandom	0.008	0.766	0.766	3168.0	0.829	0.525	7.812e-03	0.420	1.177
18	mindom	0.023	0.023	0.023	3168.0	0.053	0.063	4.883e-03	0.008	0.070
19	maxdom	0.008	4.992	4.992	3168.0	5.047	3.521	7.812e-03	2.070	7.008
20	dfrange	0.000	4.945	4.945	3168.0	4.995	3.520	0.000e+00	2.045	6.992
21	modindx	0.000	0.139	0.139	3168.0	0.174	0.119	0.000e+00	0.100	0.209

Na tabela já temos os valores para Intervalo-Interquartil e Desvio Padrão , Resta calcularmos a Amplitude , Variância e, Coeficiente de Variação e Intervalo-Interquartil.

Amplitude.

In [32]:

```
print(dataset['meanfreq'].max() - dataset['meanfreq'].min())
```

```
0.21176041613672117
```

In [ ]:

```

```

Variância.

In [33]:

```
print(dataset['meanfreq'].var())
```

```
0.0008950770245104506
```

O cálculo do coeficiente de variação é feito através da fórmula:

cv/

Onde, s → é o desvio padrão X ? → é a média dos dados CV → é o coeficiente de variação

$$CV = \frac{s}{\bar{X}} \cdot 100$$

Coeficiente de Variação.

In [34]:

```
print(   (dataset['meanfreq'].std()/dataset['meanfreq'].mean()) *  100      )
```

```
16.537725093072137
```

Intervalo-Interquartil.

É a diferença entre o terceiro quartil e o primeiro quartil, ou seja, d= Q3-Q1

In [35]:

```
print(dataset['meanfreq'].quantile(q=0.75))
```

```
0.19914605089620624
```

In [36]:

```
print(dataset['meanfreq'].quantile(q=0.25))
```

```
0.1636621363172535
```

In [37]:

```
print(dataset['meanfreq'].quantile(q=0.75) - dataset['meanfreq'].quantile(q=0.25))
```

```
0.03548391457895275
```

Operando todos cálculos: Amplitude,Variância, Coeficiente de Variação e Intervalo-Interquartil.

In [38]:

```
Amplitudedic = {}
Varianciadic = {}
CoeficienteVardic = {}
IntervaloInterquartildic = {}
for x in colunas:
    if x == "label":
        continue
    Amplitudedic[x]=dataset[x].max() - dataset[x].min()
    Varianciadic[x] = dataset[x].var()
    CoeficienteVardic[x] = (dataset[x].std()/dataset[x].mean()) *  100
    IntervaloInterquartildic[x] = dataset[x].quantile(q=0.75) - dataset[x].quantile(q=
0.25)
```

Transfomando os resultados em dataframe.

In [39]:

```
dfAmplitude = pandas.DataFrame.from_dict(Amplitudedic, orient="index").reset_index()
dfAmplitude.columns = ["quantitativas","Amplitude"]
dfAmplitude.head()
```

Out[39]:

	quantitativas	Amplitude
0	meanfreq	0.212
1	sd	0.097
2	median	0.250
3	Q25	0.247
4	Q75	0.231

In [40]:

```
dfVariancia = pandas.DataFrame.from_dict(Varianciadic, orient="index").reset_index()
dfVariancia.columns = ["quantitativas","Variancia"]
dfVariancia.head()
```

Out[40]:

	quantitativas	Variancia
0	meanfreq	8.951e-04
1	sd	2.773e-04
2	median	1.322e-03
3	Q25	2.370e-03
4	Q75	5.588e-04

In [41]:

```
dfCoeficiente = pandas.DataFrame.from_dict(CoeficienteVardic, orient="index").reset_ind
ex()
dfCoeficiente.columns = ["quantitativas","Coef_Var_%"]
dfCoeficiente.head()
```

Out[41]:

	quantitativas	Coef_Var_%
0	meanfreq	16.538
1	sd	29.150
2	median	19.588
3	Q25	34.658
4	Q75	10.517

In [42]:

```
IntervaloInterquartil = pandas.DataFrame.from_dict(IntervaloInterquartildic, orient="in
dex").reset_index()
IntervaloInterquartil.columns = ["quantitativas","Intervalo_Interquartil"]
IntervaloInterquartil.head()
```

Out[42]:

	quantitativas	Intervalo_Interquartil
0	meanfreq	0.035
1	sd	0.025
2	median	0.041
3	Q25	0.065
4	Q75	0.035

Mesclando os resultados.

In [43]:

```
dfresultado_frame=pandas.merge(dfAmplitude,dfVariancia,how='right',on='quantitativas')
dfresultado_frame=pandas.merge(dfresultado_frame,dfCoeficiente,how='right',on='quantita
tivas')
dfresultado_frame=pandas.merge(dfresultado_frame,IntervaloInterquartil,how='right',on=
'quantitativas')
print(dfresultado_frame)
dfresultado_frame
```

```
   quantitativas  Amplitude  Variancia  Coef_Var_%  Intervalo_Interquartil
0       meanfreq      0.212  8.951e-04      16.538                   0.035
1             sd      0.097  2.773e-04      29.150                   0.025
2         median      0.250  1.322e-03      19.588                   0.041
3            Q25      0.247  2.370e-03      34.658                   0.065
4            Q75      0.231  5.588e-04      10.517                   0.035
5            IQR      0.238  1.830e-03      50.745                   0.072
6           skew     34.584  1.798e+01     135.041                   1.282
7           kurt   1307.544  1.821e+04     368.976                   7.979
8         sp.ent      0.243  2.023e-03       5.025                   0.067
9            sfm      0.806  3.151e-02      43.487                   0.276
10          mode      0.280  5.960e-03      46.710                   0.103
11      centroid      0.212  8.951e-04      16.538                   0.035
12       meanfun      0.182  1.044e-03      22.621                   0.053
13        minfun      0.194  3.694e-04      52.226                   0.030
14        maxfun      0.176  9.046e-04      11.620                   0.023
15       meandom      2.950  2.758e-01      63.338                   0.757
16        mindom      0.454  4.007e-03     120.234                   0.062
17        maxdom     21.859  1.240e+01      69.763                   4.938
18       dfrange     21.844  1.239e+01      70.476                   4.947
19       modindx      0.932  1.427e-02      68.750                   0.109
```

Out[43]:

	quantitativas	Amplitude	Variancia	Coef_Var_%	Intervalo_Interquartil
0	meanfreq	0.212	8.951e-04	16.538	0.035
1	sd	0.097	2.773e-04	29.150	0.025
2	median	0.250	1.322e-03	19.588	0.041
3	Q25	0.247	2.370e-03	34.658	0.065
4	Q75	0.231	5.588e-04	10.517	0.035
5	IQR	0.238	1.830e-03	50.745	0.072
6	skew	34.584	1.798e+01	135.041	1.282
7	kurt	1307.544	1.821e+04	368.976	7.979
8	sp.ent	0.243	2.023e-03	5.025	0.067
9	sfm	0.806	3.151e-02	43.487	0.276
10	mode	0.280	5.960e-03	46.710	0.103
11	centroid	0.212	8.951e-04	16.538	0.035
12	meanfun	0.182	1.044e-03	22.621	0.053
13	minfun	0.194	3.694e-04	52.226	0.030
14	maxfun	0.176	9.046e-04	11.620	0.023
15	meandom	2.950	2.758e-01	63.338	0.757
16	mindom	0.454	4.007e-03	120.234	0.062
17	maxdom	21.859	1.240e+01	69.763	4.938
18	dfrange	21.844	1.239e+01	70.476	4.947
19	modindx	0.932	1.427e-02	68.750	0.109

Mesclando os resultados com tabela de resumo estatístico.

In [44]:

```
dados_estatisticos=pandas.merge(dados_estatisticos,dfresultado_frame,how='right',on='qu
antitativas')
#dados_estatisticos[[quantitativas]]
#dados_estatisticos = dados_estatisticos.drop_duplicates()
print(dados_estatisticos)
#dados_estatisticos = dados_estatisticos[["quantitativas"]]
#print(dados_estatisticos)
dados_estatisticos
```

	quantitativas	moda	mediana	50%	count	mean	std	mi
n	25%	75%	\					
0	meanfreq	0.212	0.185	0.185	3168.0	0.181	0.030	3.936e-0
2	0.164	0.199						
1	meanfreq	0.212	0.185	0.185	3168.0	0.181	0.030	3.936e-0
2	0.164	0.199						
2	centroid	0.212	0.185	0.185	3168.0	0.181	0.030	3.936e-0
2	0.164	0.199						
3	centroid	0.212	0.185	0.185	3168.0	0.181	0.030	3.936e-0
2	0.164	0.199						
4	sd	0.043	0.059	0.059	3168.0	0.057	0.017	1.836e-0
2	0.042	0.067						
5	median	0.187	0.190	0.190	3168.0	0.186	0.036	1.097e-0
2	0.170	0.211						
6	Q25	0.140	0.140	0.140	3168.0	0.140	0.049	2.288e-0
4	0.111	0.176						
7	Q75	0.240	0.226	0.226	3168.0	0.225	0.024	4.295e-0
2	0.209	0.244						
8	IQR	0.035	0.094	0.094	3168.0	0.084	0.043	1.456e-0
2	0.043	0.114						
9	skew	1.863	2.197	2.197	3168.0	3.140	4.241	1.417e-0
1	1.650	2.932						
10	kurt	6.110	8.318	8.318	3168.0	36.568	134.929	2.068e+0
0	5.670	13.649						
11	sp.ent	0.860	0.902	0.902	3168.0	0.895	0.045	7.387e-0
1	0.862	0.929						
12	sfm	0.085	0.396	0.396	3168.0	0.408	0.178	3.688e-0
2	0.258	0.534						
13	mode	0.000	0.187	0.187	3168.0	0.165	0.077	0.000e+0
0	0.118	0.221						
14	meanfun	0.134	0.141	0.141	3168.0	0.143	0.032	5.557e-0
2	0.117	0.170						
15	minfun	0.047	0.046	0.046	3168.0	0.037	0.019	9.775e-0
3	0.018	0.048						
16	maxfun	0.279	0.271	0.271	3168.0	0.259	0.030	1.031e-0
1	0.254	0.277						
17	meandom	0.008	0.766	0.766	3168.0	0.829	0.525	7.812e-0
3	0.420	1.177						
18	mindom	0.023	0.023	0.023	3168.0	0.053	0.063	4.883e-0
3	0.008	0.070						
19	maxdom	0.008	4.992	4.992	3168.0	5.047	3.521	7.812e-0
3	2.070	7.008						
20	dfrange	0.000	4.945	4.945	3168.0	4.995	3.520	0.000e+0
0	2.045	6.992						
21	modindx	0.000	0.139	0.139	3168.0	0.174	0.119	0.000e+0
0	0.100	0.209						

	max	Amplitude	Variancia	Coef_Var_%	Intervalo_Interquartil
0	0.251	0.212	8.951e-04	16.538	0.035
1	0.251	0.212	8.951e-04	16.538	0.035
2	0.251	0.212	8.951e-04	16.538	0.035
3	0.251	0.212	8.951e-04	16.538	0.035
4	0.115	0.097	2.773e-04	29.150	0.025
5	0.261	0.250	1.322e-03	19.588	0.041
6	0.247	0.247	2.370e-03	34.658	0.065
7	0.273	0.231	5.588e-04	10.517	0.035
8	0.252	0.238	1.830e-03	50.745	0.072
9	34.725	34.584	1.798e+01	135.041	1.282
10	1309.613	1307.544	1.821e+04	368.976	7.979
11	0.982	0.243	2.023e-03	5.025	0.067
12	0.843	0.806	3.151e-02	43.487	0.276

```
13      0.280       0.280  5.960e-03      46.710                0.103
14      0.238       0.182  1.044e-03      22.621                0.053
15      0.204       0.194  3.694e-04      52.226                0.030
16      0.279       0.176  9.046e-04      11.620                0.023
17      2.958       2.950  2.758e-01      63.338                0.757
18      0.459       0.454  4.007e-03     120.234                0.062
19     21.867      21.859  1.240e+01      69.763                4.938
20     21.844      21.844  1.239e+01      70.476                4.947
21      0.932       0.932  1.427e-02      68.750                0.109
```

Out[44]:

	quantitativas	moda	mediana	50%	count	mean	std	min	25%	75%
0	meanfreq	0.212	0.185	0.185	3168.0	0.181	0.030	3.936e-02	0.164	0.199
1	meanfreq	0.212	0.185	0.185	3168.0	0.181	0.030	3.936e-02	0.164	0.199
2	centroid	0.212	0.185	0.185	3168.0	0.181	0.030	3.936e-02	0.164	0.199
3	centroid	0.212	0.185	0.185	3168.0	0.181	0.030	3.936e-02	0.164	0.199
4	sd	0.043	0.059	0.059	3168.0	0.057	0.017	1.836e-02	0.042	0.067
5	median	0.187	0.190	0.190	3168.0	0.186	0.036	1.097e-02	0.170	0.211
6	Q25	0.140	0.140	0.140	3168.0	0.140	0.049	2.288e-04	0.111	0.176
7	Q75	0.240	0.226	0.226	3168.0	0.225	0.024	4.295e-02	0.209	0.244
8	IQR	0.035	0.094	0.094	3168.0	0.084	0.043	1.456e-02	0.043	0.114
9	skew	1.863	2.197	2.197	3168.0	3.140	4.241	1.417e-01	1.650	2.932
10	kurt	6.110	8.318	8.318	3168.0	36.568	134.929	2.068e+00	5.670	13.649
11	sp.ent	0.860	0.902	0.902	3168.0	0.895	0.045	7.387e-01	0.862	0.929
12	sfm	0.085	0.396	0.396	3168.0	0.408	0.178	3.688e-02	0.258	0.534
13	mode	0.000	0.187	0.187	3168.0	0.165	0.077	0.000e+00	0.118	0.221
14	meanfun	0.134	0.141	0.141	3168.0	0.143	0.032	5.557e-02	0.117	0.170
15	minfun	0.047	0.046	0.046	3168.0	0.037	0.019	9.775e-03	0.018	0.048
16	maxfun	0.279	0.271	0.271	3168.0	0.259	0.030	1.031e-01	0.254	0.277
17	meandom	0.008	0.766	0.766	3168.0	0.829	0.525	7.812e-03	0.420	1.177
18	mindom	0.023	0.023	0.023	3168.0	0.053	0.063	4.883e-03	0.008	0.070
19	maxdom	0.008	4.992	4.992	3168.0	5.047	3.521	7.812e-03	2.070	7.008
20	dfrange	0.000	4.945	4.945	3168.0	4.995	3.520	0.000e+00	2.045	6.992
21	modindx	0.000	0.139	0.139	3168.0	0.174	0.119	0.000e+00	0.100	0.209

ORGANIZAÇÃO E REPRESENTAÇÃO DOS DADOS

Tabela de freqüência: relaciona categorias (ou classes) de valores,juntamente com contagem (ou freqüências) do número de valores que se enquadram em cada categoria ou classe.

Variáveis qualitativas:

Temos apenas uma classe qualitativa a variável *label* fazendo a análise:

Tamanho do dataset.

In [45]:

```
print(dataset.shape)
```

```
(3168, 21)
```

Agrupar pela variável label.

In [46]:

```
contagem = dataset.groupby('label').size()
print(contagem)
```

```
label
female    1584
male      1584
dtype: int64
```

Prepara os resultados.

In [47]:

```
print(contagem[['female']][0])
```

```
1584
```

In [48]:

```
print(contagem[['male']][0])
```

```
1584
```

In [49]:

```
total=contagem[['female']][0] + contagem[['male']][0]
```

In [50]:

```
print(total)
```

```
3168
```

Calculando a frequência relativa. fr =fi / n ou seja contagem por classe sobre total somada dos valores de cada classe.

In [51]:

```
freqFRsexodic={}
freqFRsexodic['female']=   contagem[['female']][0] / total
freqFRsexodic['male']=    contagem[['male']][0] / total
freqFRsexodic['Total']=   (  contagem[['female']][0] / total ) + (  contagem[['male']][
0] / total)
```

In [52]:

```
freqFRsexodic
```

Out[52]:

```
{'female': 0.5, 'male': 0.5, 'Total': 1.0}
```

Calculando a Frequência relativa percentual da categoria. fri% = fri * 100

In [53]:

```
freqFRpcsexodic={}
freqFRpcsexodic['female']=   freqFRsexodic['female'] * 100
freqFRpcsexodic['male']=    freqFRsexodic['male']  * 100
freqFRpcsexodic['Total']=  freqFRsexodic['Total']  * 100
```

In [54]:

```
freqFRpcsexodic
```

Out[54]:

```
{'female': 50.0, 'male': 50.0, 'Total': 100.0}
```

In [ ]:

```

```

In [55]:

```
freqsexodic={}
freqsexodic['female']=contagem[['female']][0]
freqsexodic['male']=contagem[['male']][0]
freqsexodic['Total']=total
```

In [56]:

```
freqsexodic
```

Out[56]:

```
{'female': 1584, 'male': 1584, 'Total': 3168}
```

Montado o drataframe com os resultados.

In [57]:

```
dffrequenciaSexo = pandas.DataFrame.from_dict(freqsexodic, orient="index").reset_index
()
dffrequenciaSexo.columns = ["qualitivas","contagem"]
```

In [58]:

```
dffrequenciaSexoFR = pandas.DataFrame.from_dict(freqFRsexodic, orient="index").reset_in
dex()
dffrequenciaSexoFR.columns = ["qualitivas","freqRelativa"]
```

In [59]:

```
dffrequenciaSexoFRpc = pandas.DataFrame.from_dict(freqFRpcsexodic, orient="index").rese
t_index()
dffrequenciaSexoFRpc.columns = ["qualitivas","freqRelativa%"]
```

In [60]:

```
dftabelaFreqQualitativas=pandas.merge(dffrequenciaSexo,dffrequenciaSexoFR,how='right',o
n='qualitivas')
dftabelaFreqQualitativas=pandas.merge(dftabelaFreqQualitativas,dffrequenciaSexoFRpc,how
='right',on='qualitivas')
```

In [61]:

```
dftabelaFreqQualitativas
```

Out[61]:

	qualitivas	contagem	freqRelativa	freqRelativa%
0	female	1584	0.5	50.0
1	male	1584	0.5	50.0
2	Total	3168	1.0	100.0

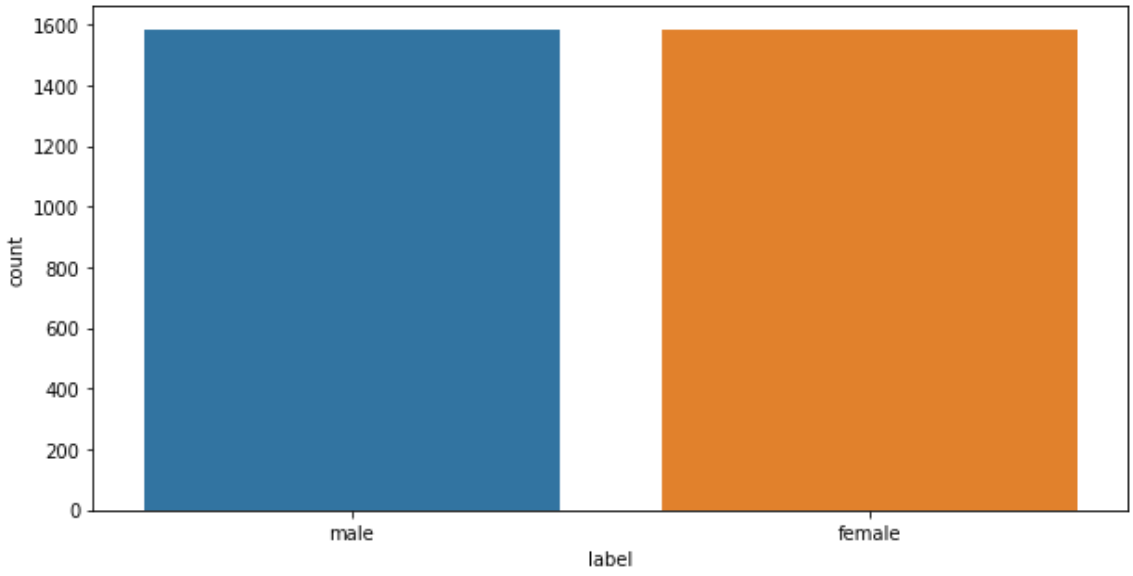
In [62]:

```
print(dftabelaFreqQualitativas)
```

```
  qualitivas  contagem  freqRelativa  freqRelativa%
0     female      1584           0.5           50.0
1       male      1584           0.5           50.0
2      Total      3168           1.0          100.0
```

In [63]:

```
sb.countplot('label',data=dataset)
plt.rcParams['figure.figsize'] = (10,5)
plt.show()
```



Organização e representação de variáveis quantitativas: Quantitativas continuas:

Procedimento de construção de tabelas de freqüência para variáveis contínuas: h = \frac{A}{k}

1. Escolha o número de intervalos de classe (k)
2. Identifique o menor valor (MIN) e o valor máximo (MAX) dos dados.
3. Calcule a amplitude dos dados (A): A=MAX –MIN
4. Calcule o comprimento de cada intervalo de classe (h):
5. Arredonde o valor de h de forma que seja obtido um número conveniente.
6. Obtenha os limites de cada intervalo de classe.
7. Construa uma tabela de freqüências, constituída pelas seguintes colunas: • Número de ordem de cada intervalo (i) • Limites de cada intervalo. Os intervalos são fechados á esquerda e aberta à direita: NOTAÇÃO:|----

Devido à complexidade (Muitas operações) dos cálculos vamos analisar via Histograma.

Uma forma de calcular via pandas, Tabela muito elevada no resultado.

In [64]:

```
pandas.DataFrame(dataset['meanfreq'].value_counts(normalize=True)).head()
```

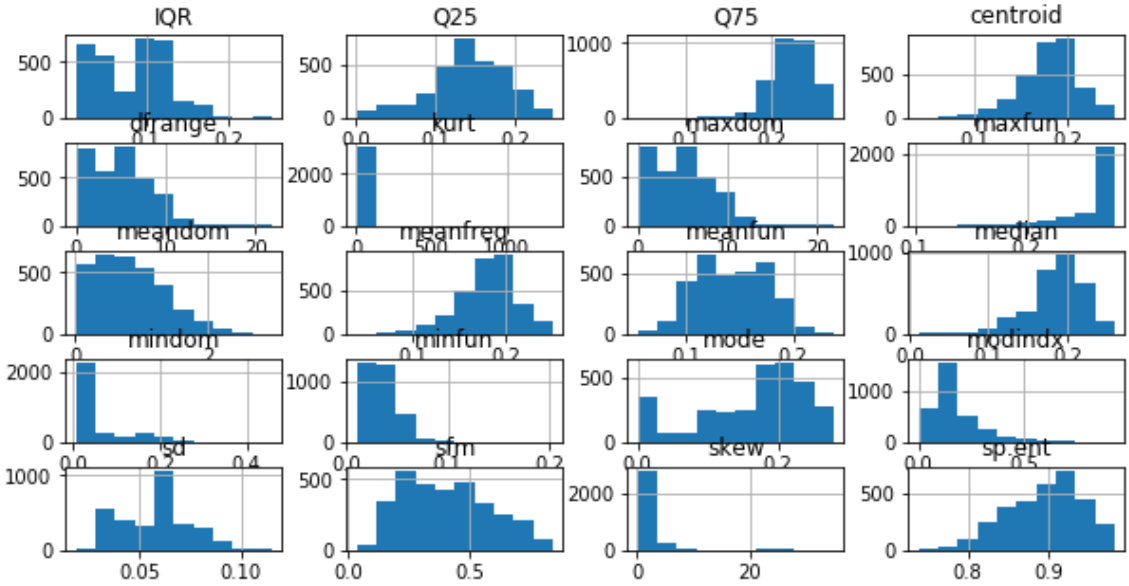
Out[64]:

	meanfreq
0.212	6.313e-04
0.214	6.313e-04
0.229	3.157e-04
0.100	3.157e-04
0.160	3.157e-04

Histograma de freqüências relativas.

In [65]:

```
dataset.hist()
plt.rcParams['figure.figsize'] = (18,18)
plt.show()
```



Fracionado os histogramas

In [66]:

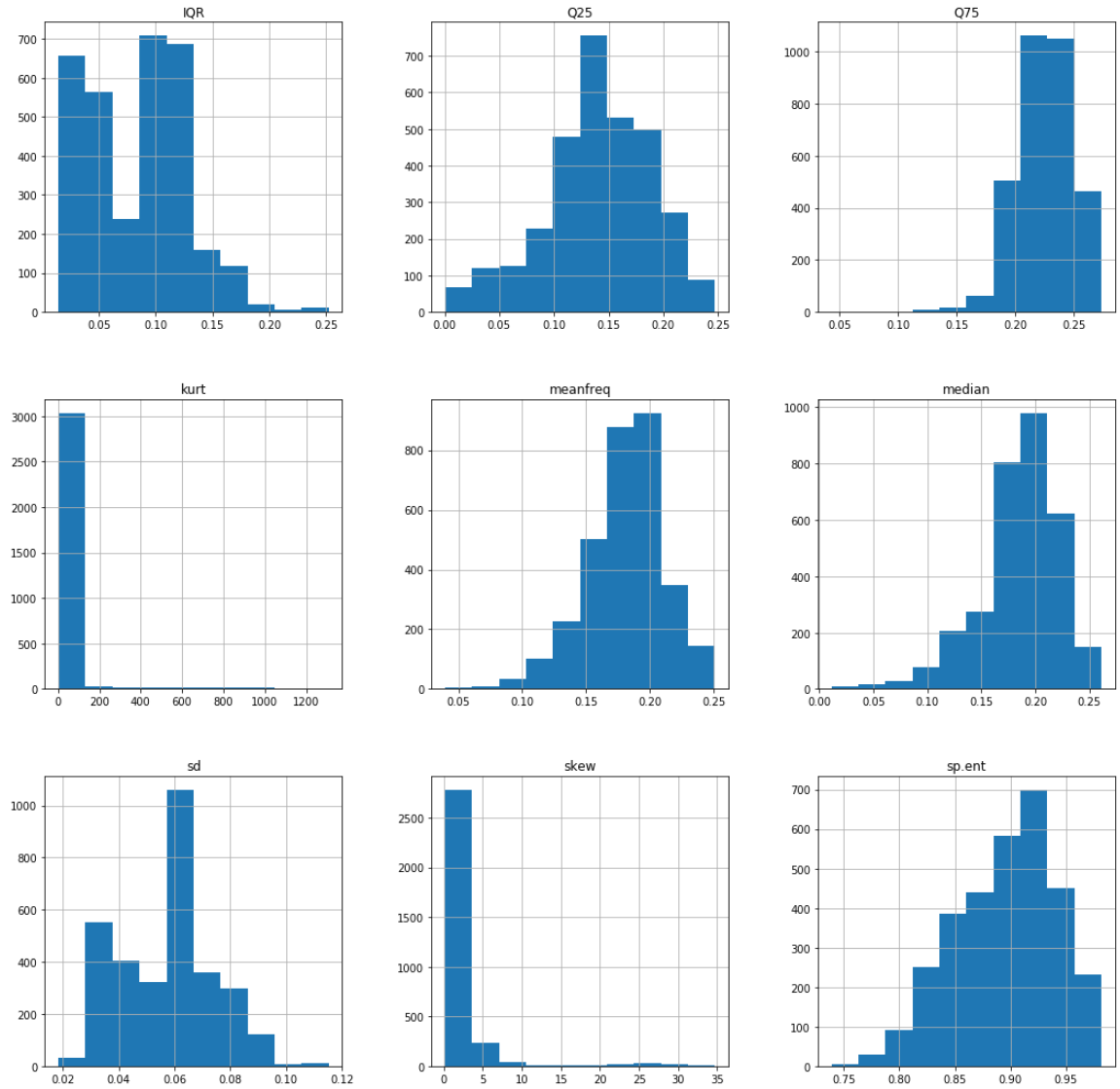
```
### Fracionado os histogramas
n=0
```

In [67]:

```
Part=dataset[colunas[n:n+9]]
n=n+9 -1
Part.hist()
```

Out[67]:

```
array([[<matplotlib.axes._subplots.AxesSubplot object at 0x1361EDF0>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x13BC5D90>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x150C6A90>],
       [<matplotlib.axes._subplots.AxesSubplot object at 0x150DC9B0>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x14FA98D0>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x14FC47F0>],
       [<matplotlib.axes._subplots.AxesSubplot object at 0x14FE0750>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x14FFA0F0>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x14FFA630>]],
      dtype=object)
```

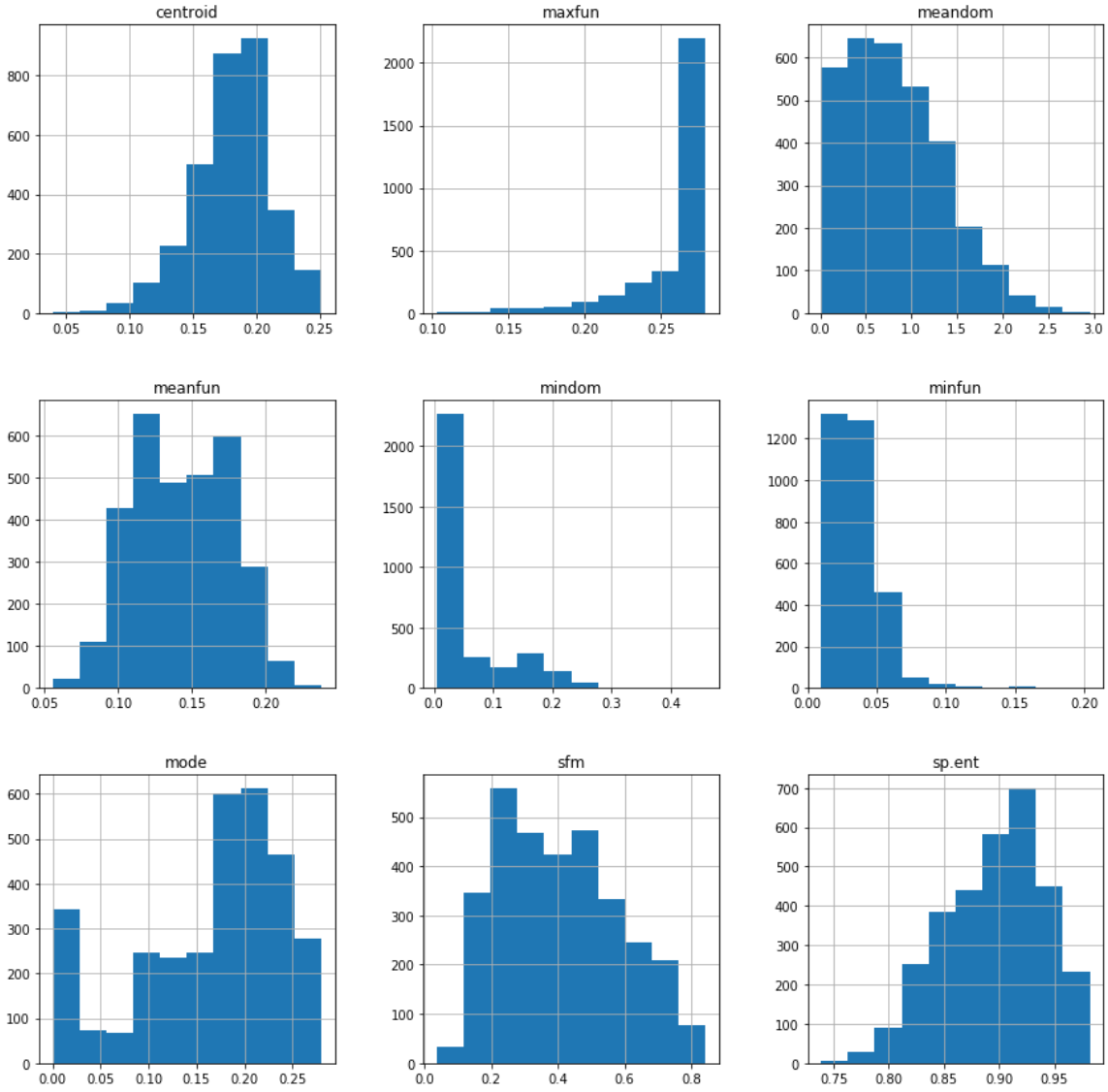


In [68]:

```
plt.rcParams['figure.figsize'] = (15,15)
plt.show()



Part=dataset[colunas[n:n+9]]
n=n+9
Part.hist()
```

Out[68]:

```
array([[<matplotlib.axes._subplots.AxesSubplot object at 0x138EB430>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x13612030>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x13629410>],
       [<matplotlib.axes._subplots.AxesSubplot object at 0x13AD8150>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x13AB6E70>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x13AAC9F0>],
       [<matplotlib.axes._subplots.AxesSubplot object at 0x13AE4930>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x13B146D0>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x13AB8F50>]],
      dtype=object)
```

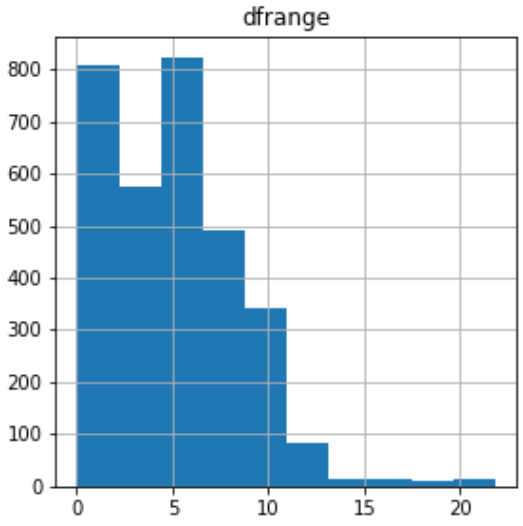


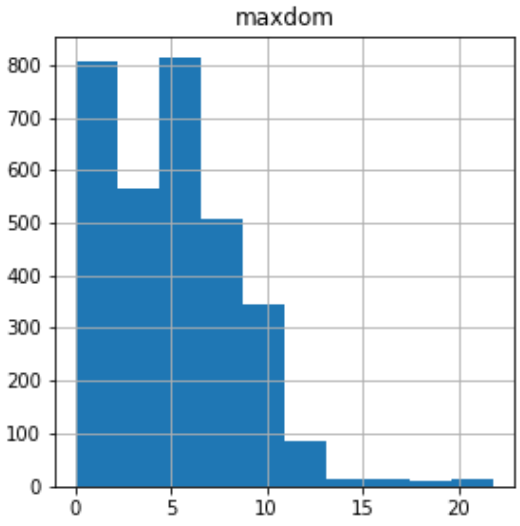
In [69]:

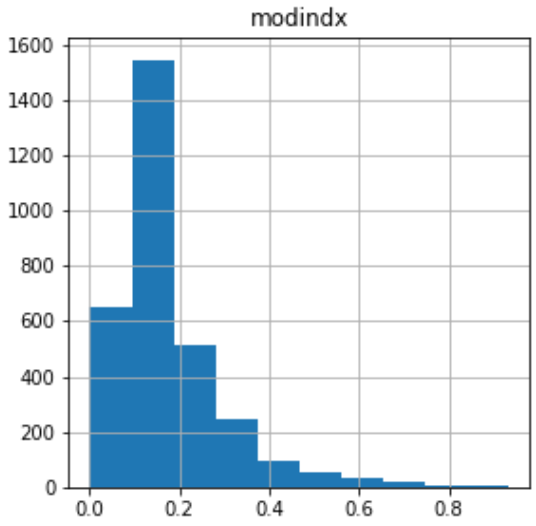
```
Part=dataset[colunas[n:n+9]]
plt.rcParams['figure.figsize'] = (10,10)
plt.show()
Part.hist()
```

Out[69]:

```
array([[<matplotlib.axes._subplots.AxesSubplot object at 0x136CE650>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x13693250>],
       [<matplotlib.axes._subplots.AxesSubplot object at 0x136B4A90>,
        <matplotlib.axes._subplots.AxesSubplot object at 0x13681B70>]],
      dtype=object)
```







Histograma usando densidade de frequência e Assimetria da distribuição.

Assimetria da distribuição.

As = \frac{\mu3}{\sigma^{2}}

Dessa forma podemos classificar o coeficiente de assimetria da seguinte forma:

- Se As=0, distribuição é simétrica
- Se As>0, distribuição assimétrica a direita (positiva)
- Se As<0, distribuição assimétrica a esquerda (negativa) Fonte: Ferreira, D. F. Estatística Básica. Ed. UFLA, 2005. 664 p.

In [70]:

```
# PANDAS: Skew Assiemetria da distribuição
skew = dataset.skew()
print(skew)
```

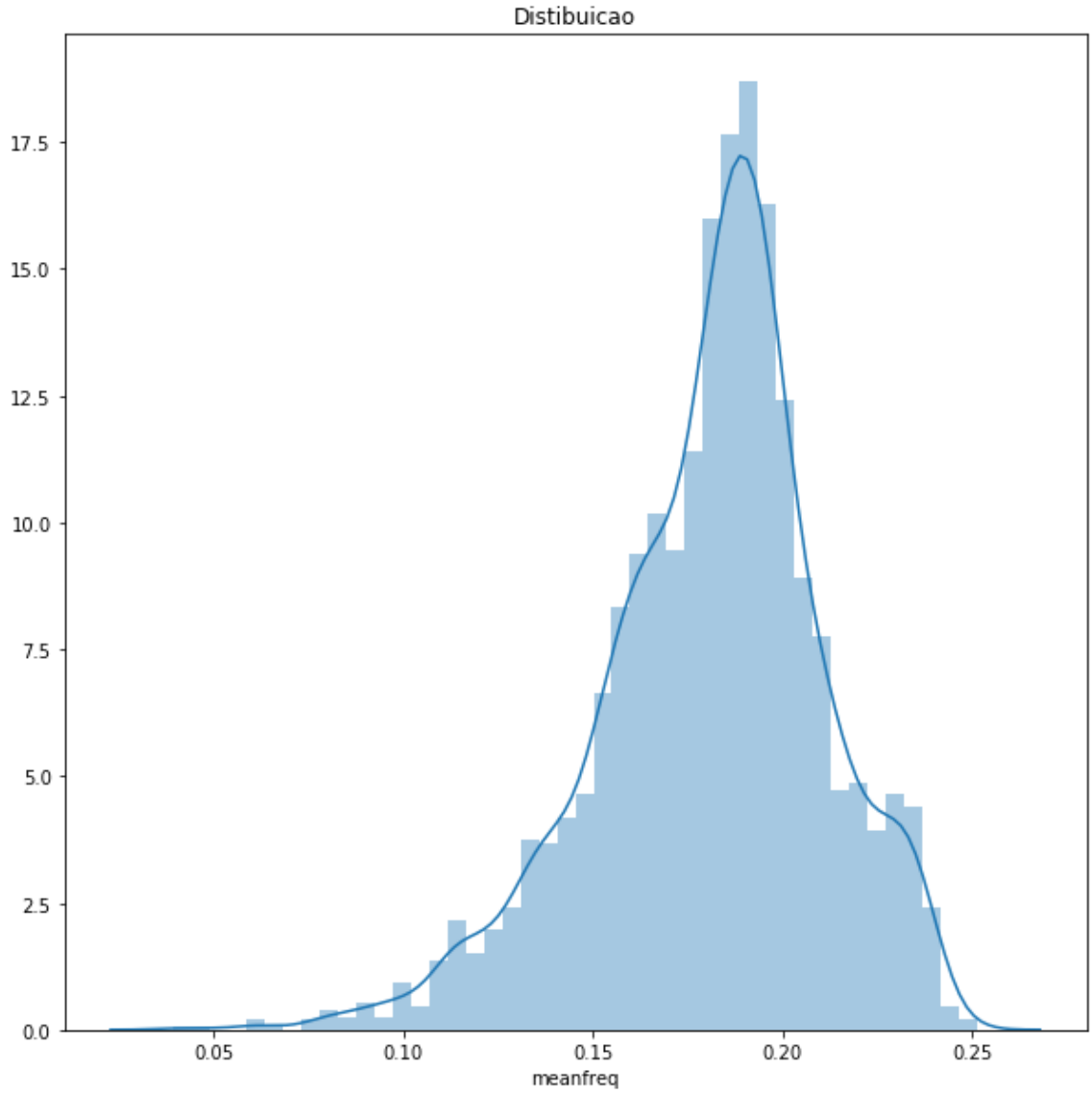
```
meanfreq   -0.617
sd          0.137
median     -1.013
Q25        -0.491
Q75        -0.900
IQR         0.295
skew        4.933
kurt        5.873
sp.ent     -0.431
sfm         0.340
mode       -0.837
centroid   -0.617
meanfun     0.039
minfun      1.878
maxfun     -2.239
meandom     0.611
mindom      1.661
maxdom      0.726
dfrange     0.728
modindx     2.064
dtype: float64
```

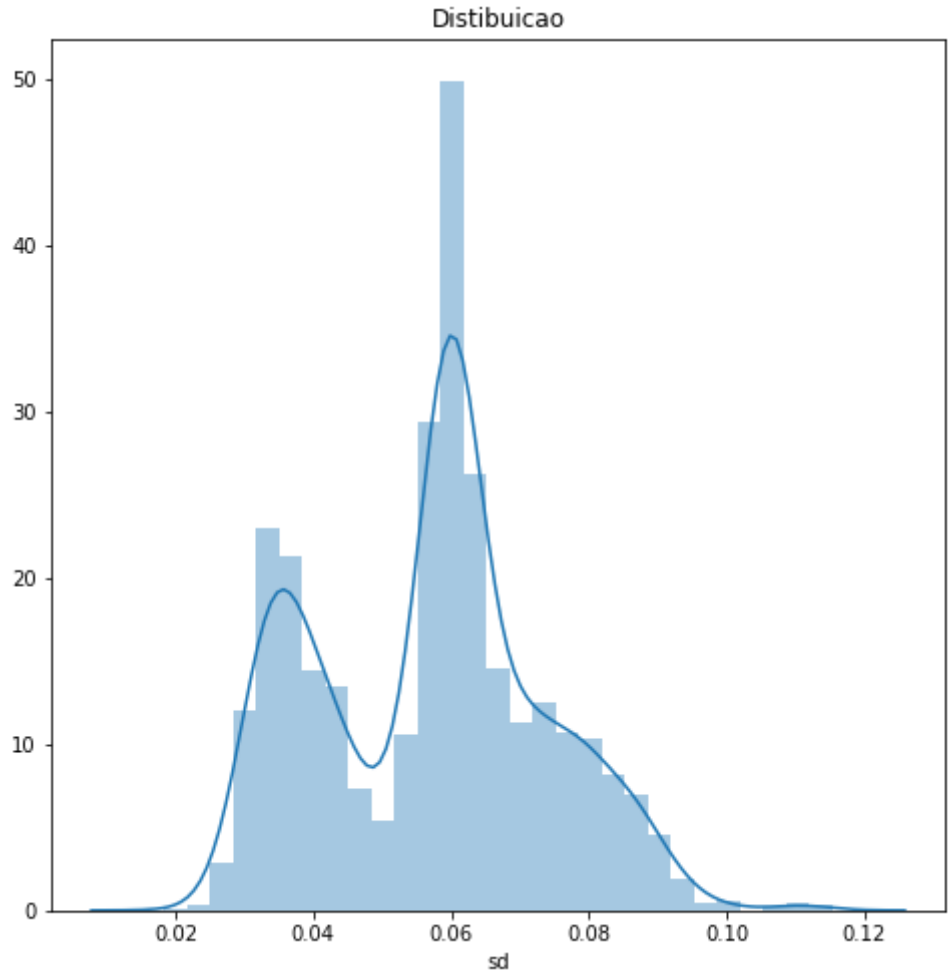
In [ ]:

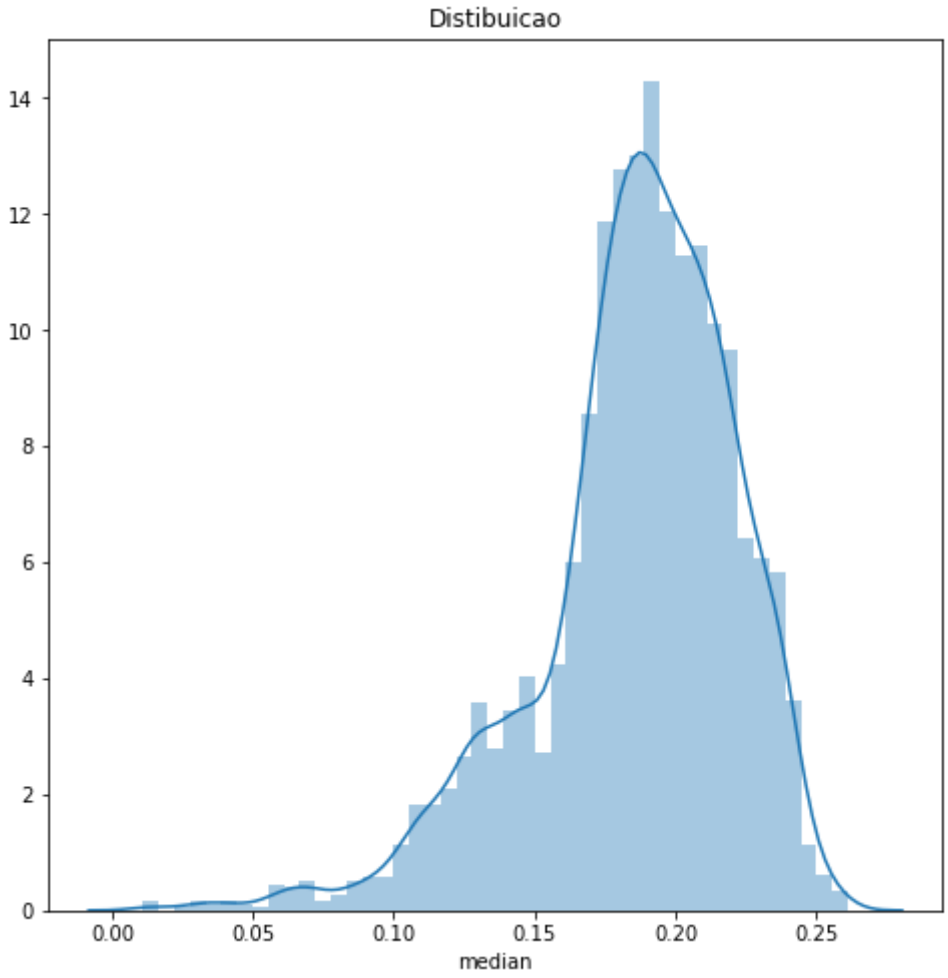
```

```

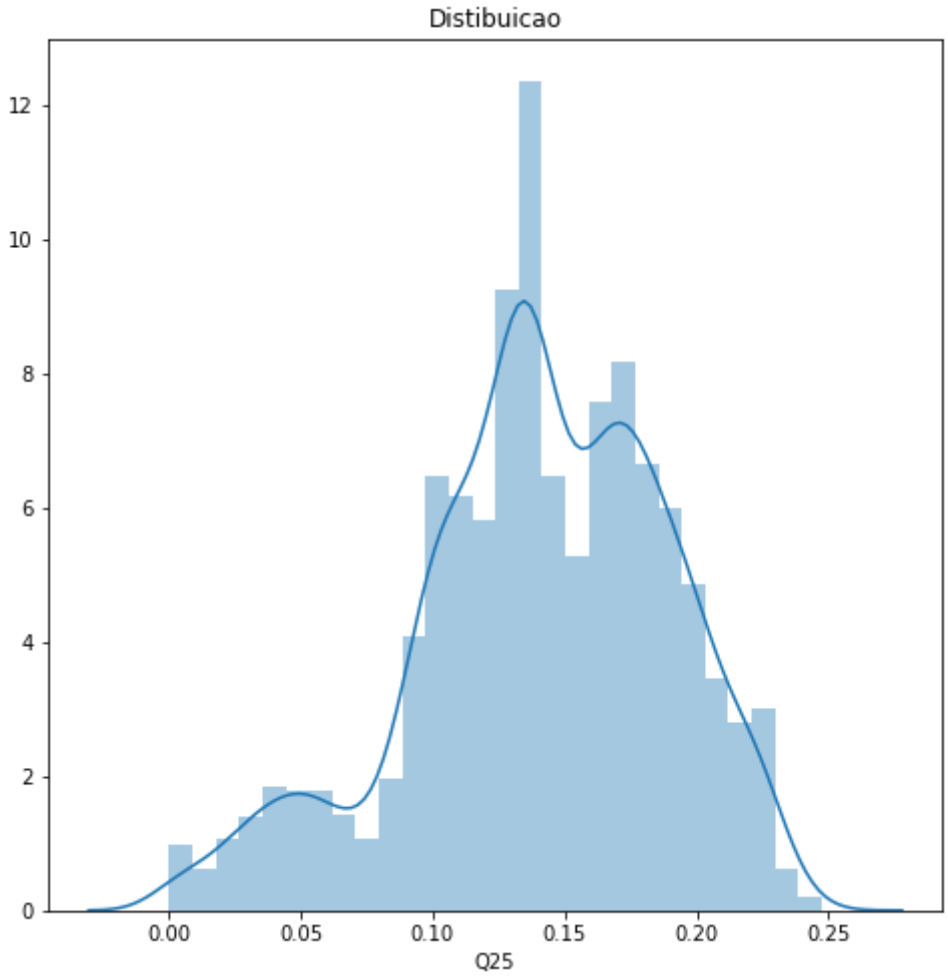
In [71]:

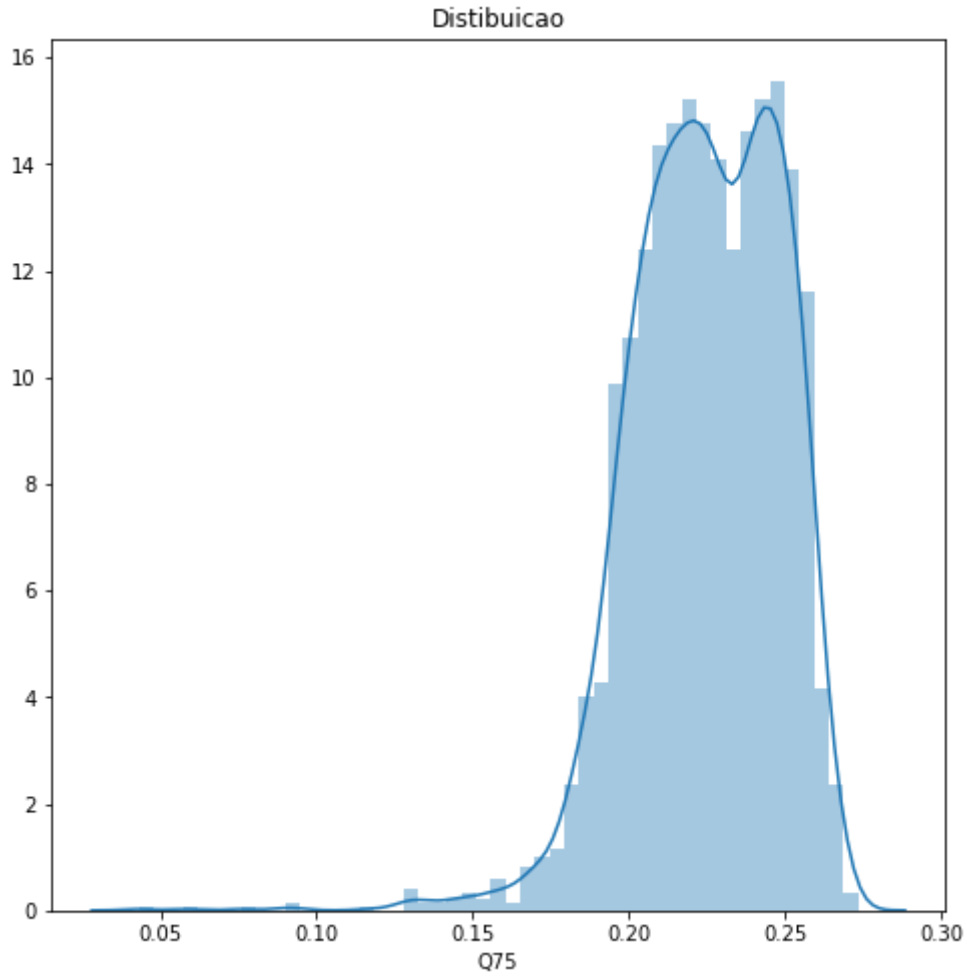
```
for y in colunas:
    if y == "label":
        continue
    Income = sb.distplot(dataset[y])
    plt.title("Distibuicao")
    plt.rcParams['figure.figsize'] = (8,8)
    plt.show(y)
```

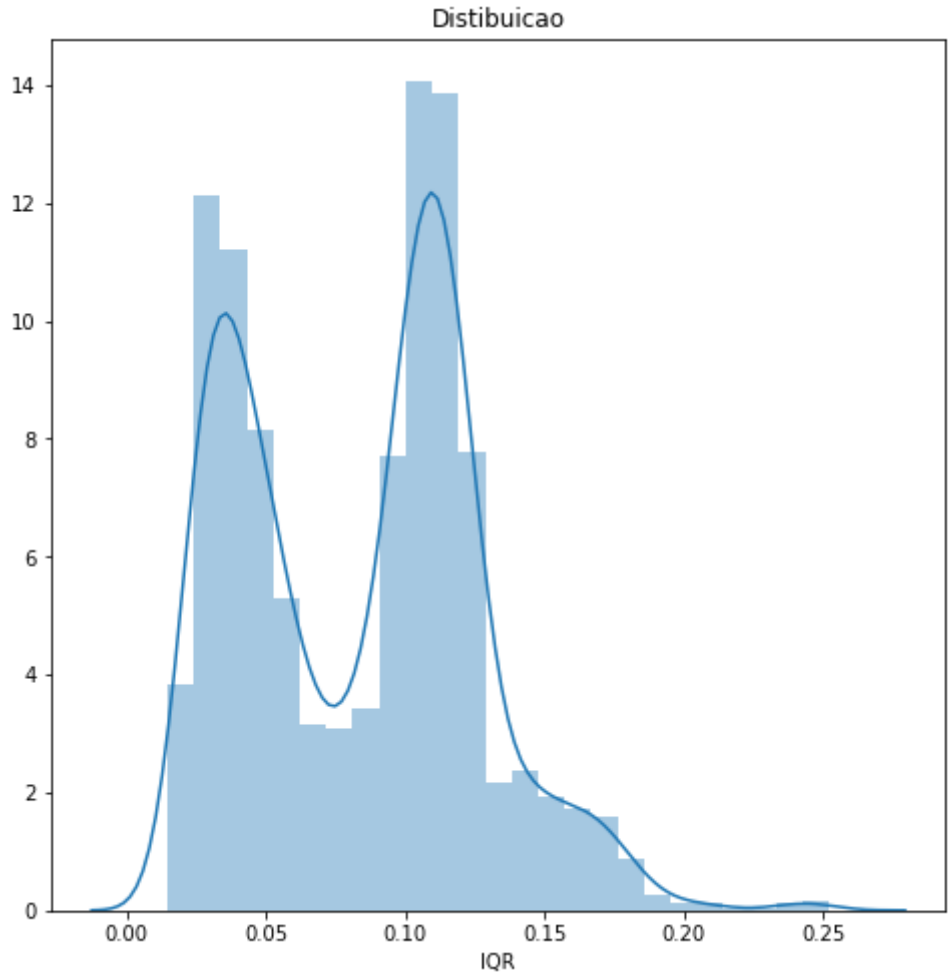

Distibuicao
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
0.05
0.10
0.15
0.20
0.25
meanfreq

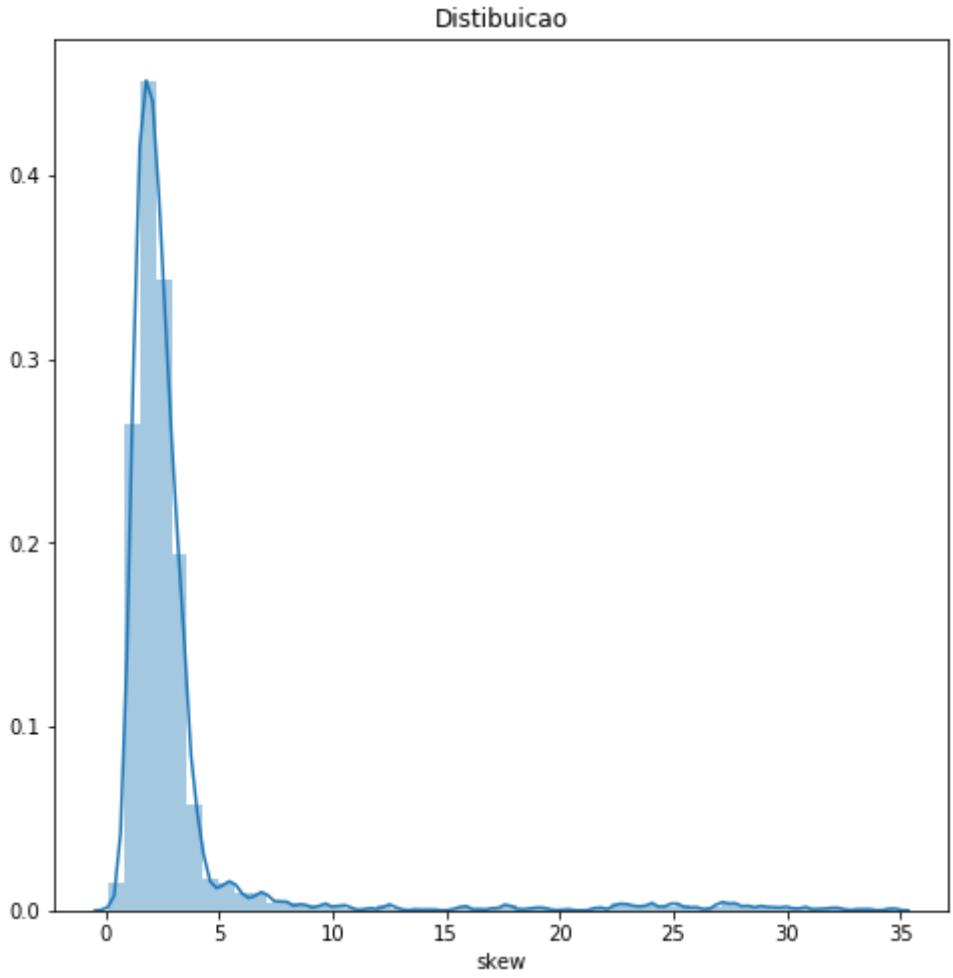

Distibuicao
50
40
30
20
10
0
0.02
0.04
0.06
0.08
0.10
0.12
sd

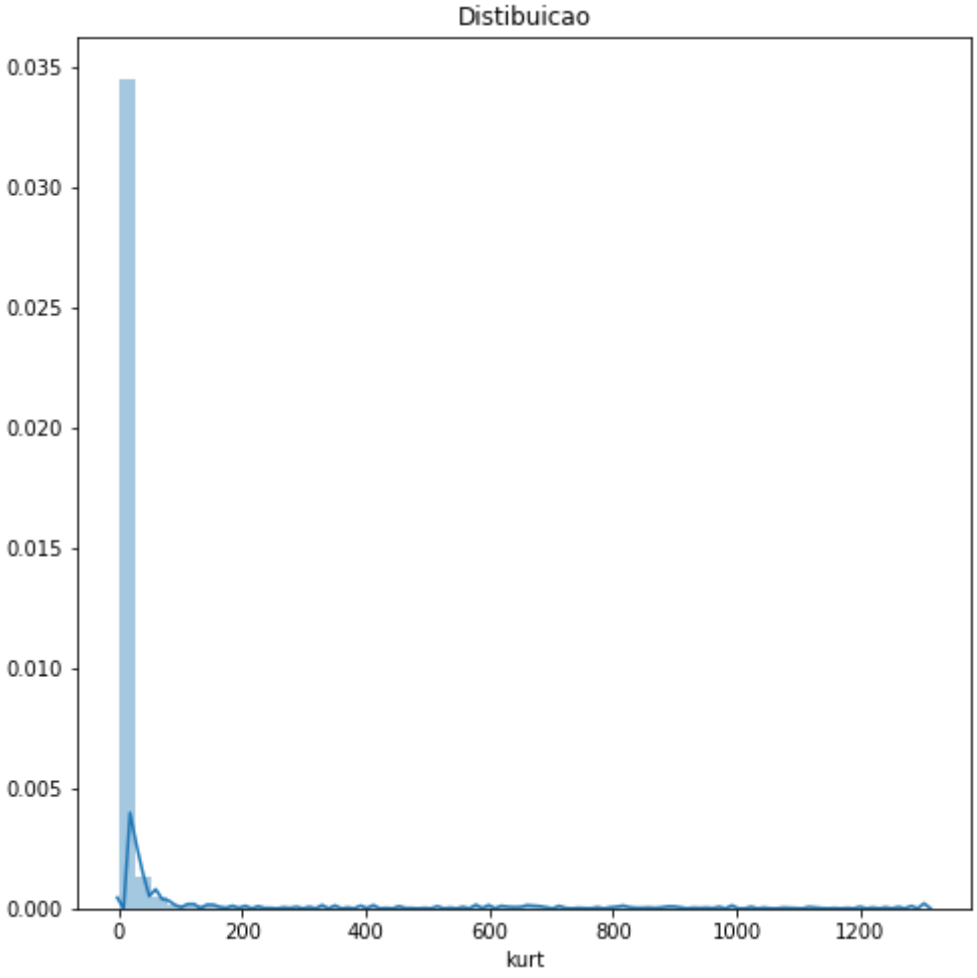

Distibuicao
14
12
10
8
6
4
2
0
0.00
0.05
0.10
0.15
0.20
0.25
median

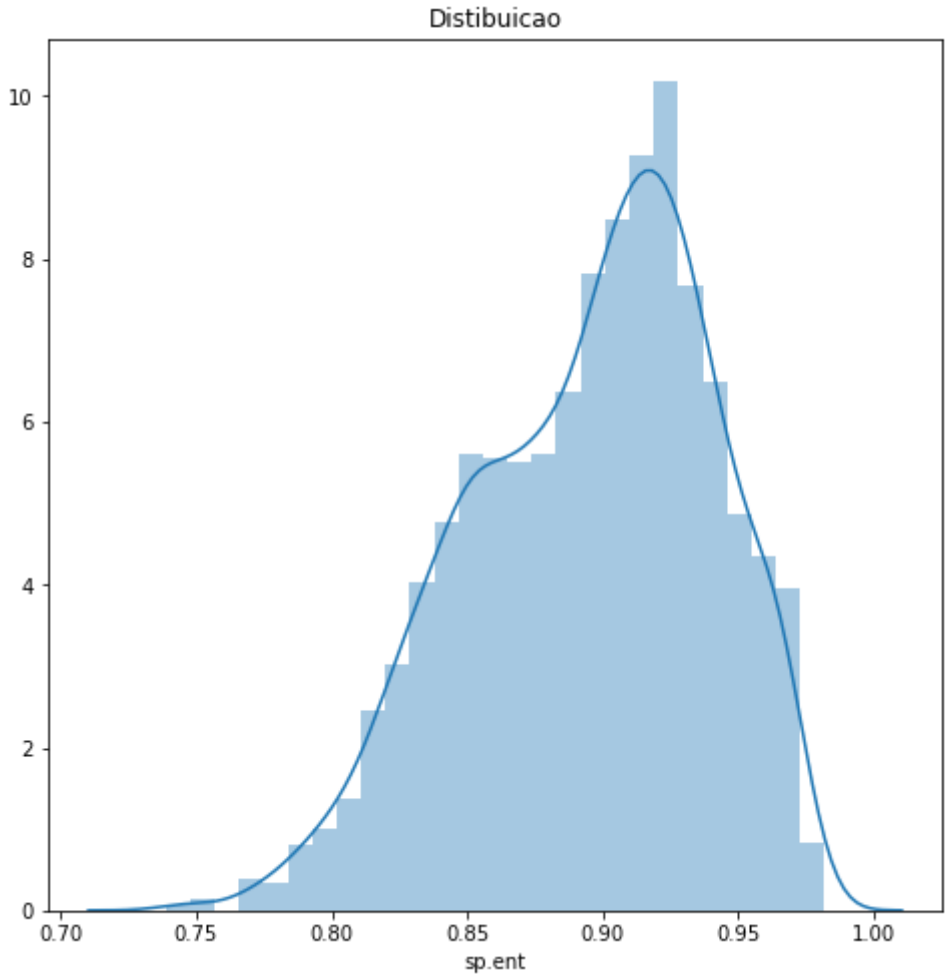

Distibuicao
12
10
8
6
4
2
0
0.00
0.05
0.10
0.15
0.20
0.25
Q25

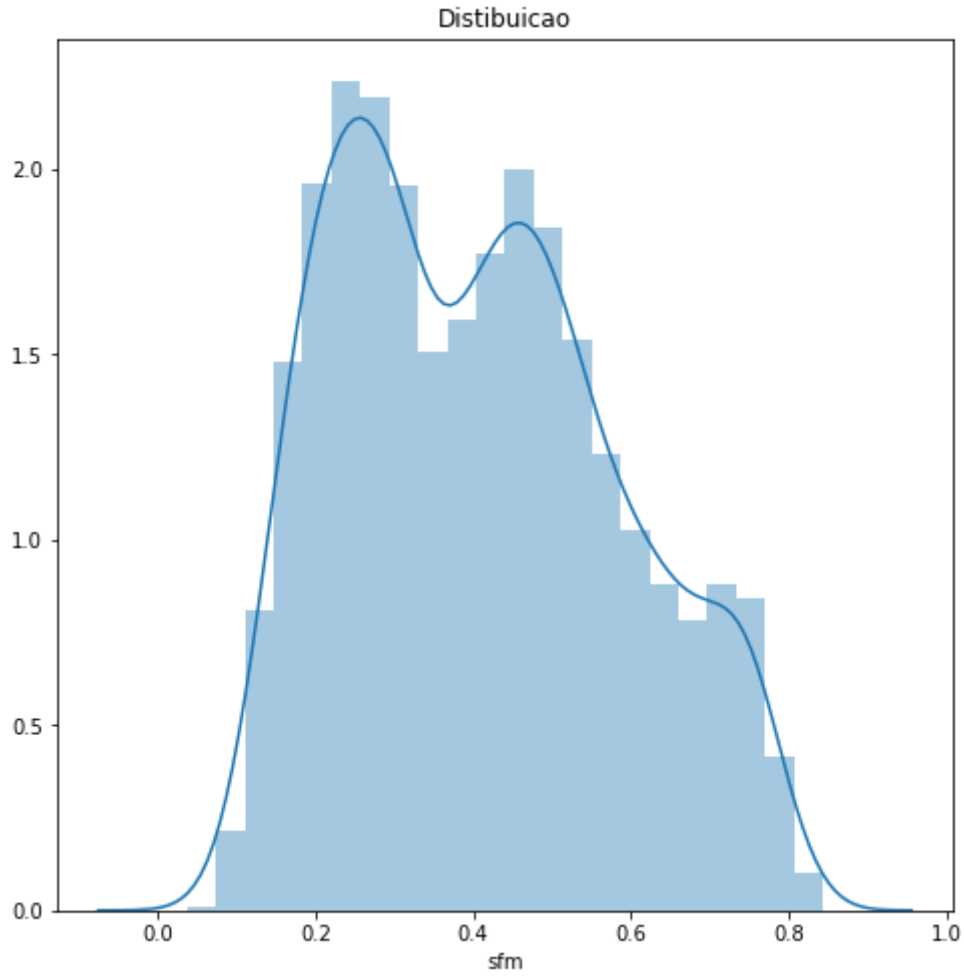

Distibuicao
16
14
12
10
8
6
4
2
0
0.05
0.10
0.15
0.20
0.25
0.30
Q75

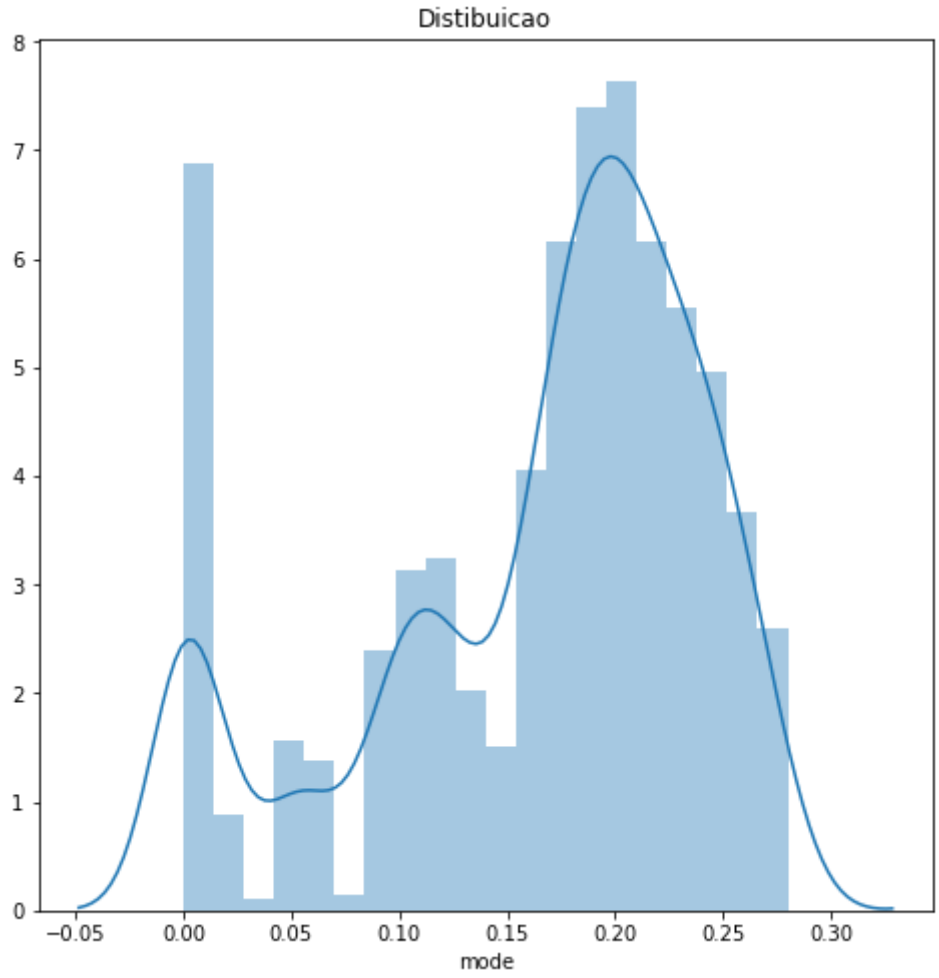

Distibuicao
14
12
10
8
6
4
2
0
0.00
0.05
0.10
0.15
0.20
0.25
IQR

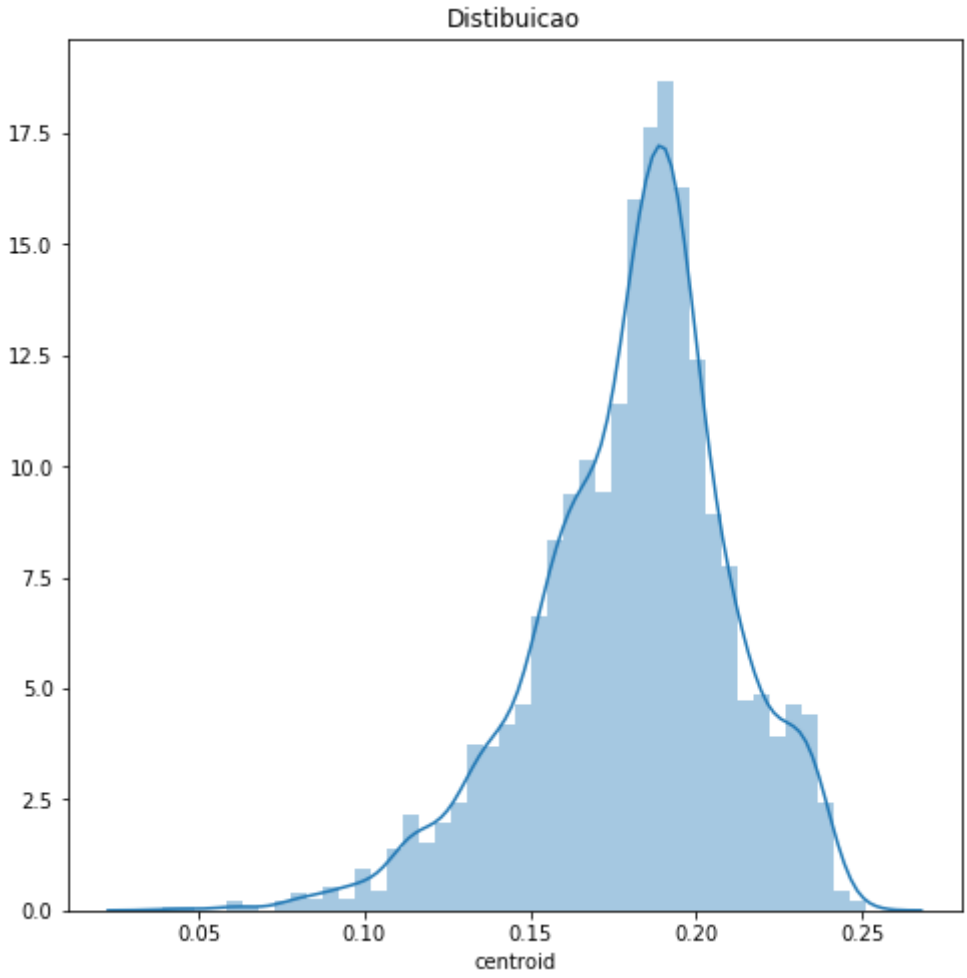

Distibuicao
0.4
0.3
0.2
0.1
0.0
0
5
10
15
20
25
30
35
skew

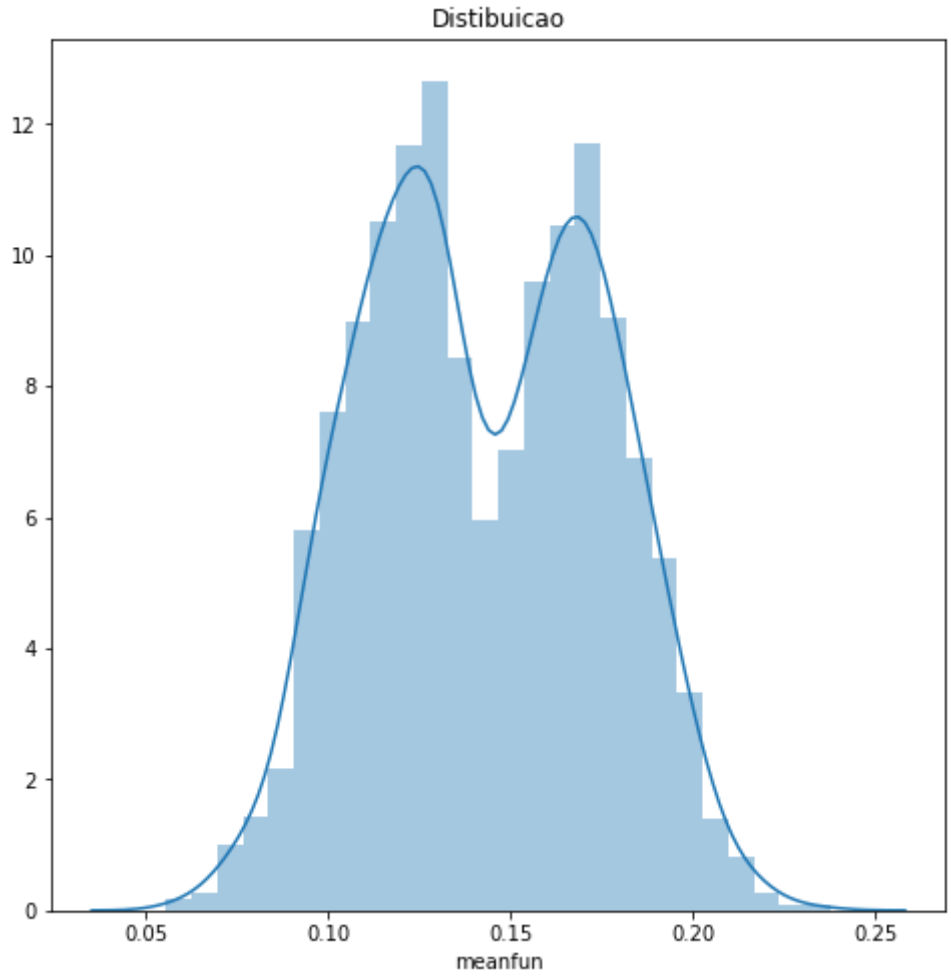

Distibuicao
0.035
0.030
0.025
0.020
0.015
0.010
0.005
0.000
0
200
400
600
800
1000
1200
kurt

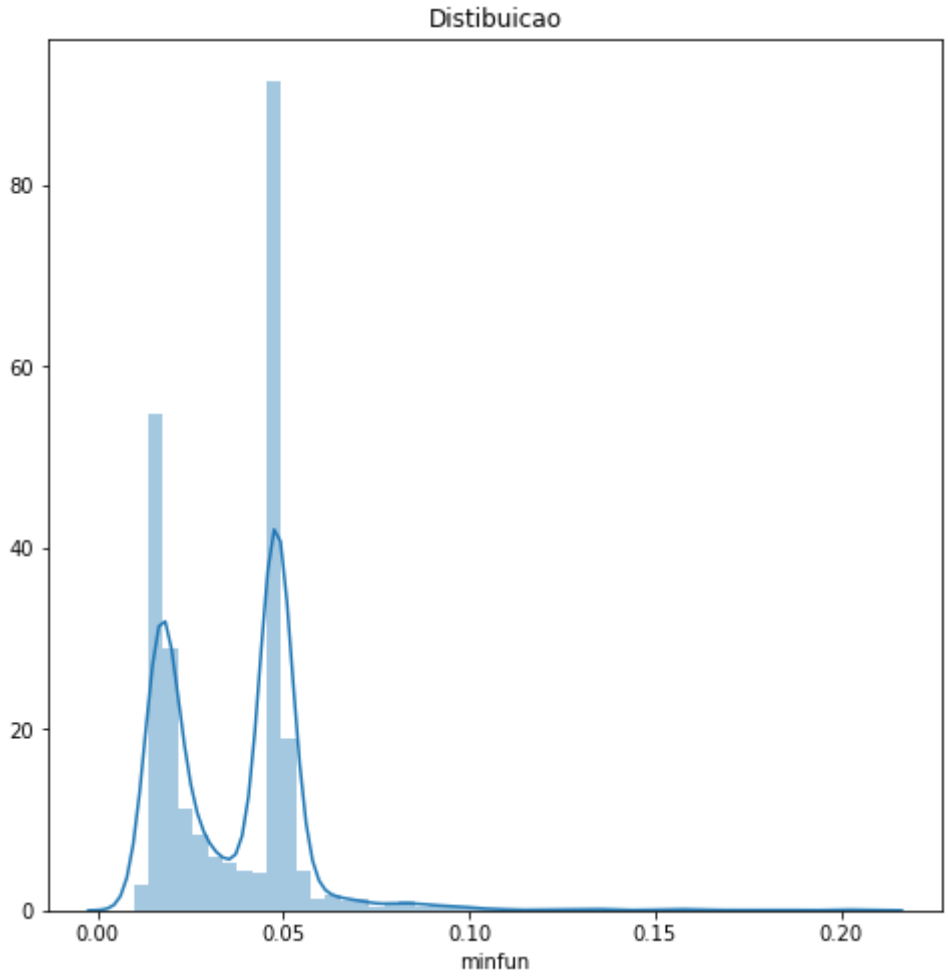

Distibuicao
10
8
6
4
2
0
0.70
0.75
0.80
0.85
0.90
0.95
1.00
sp.ent

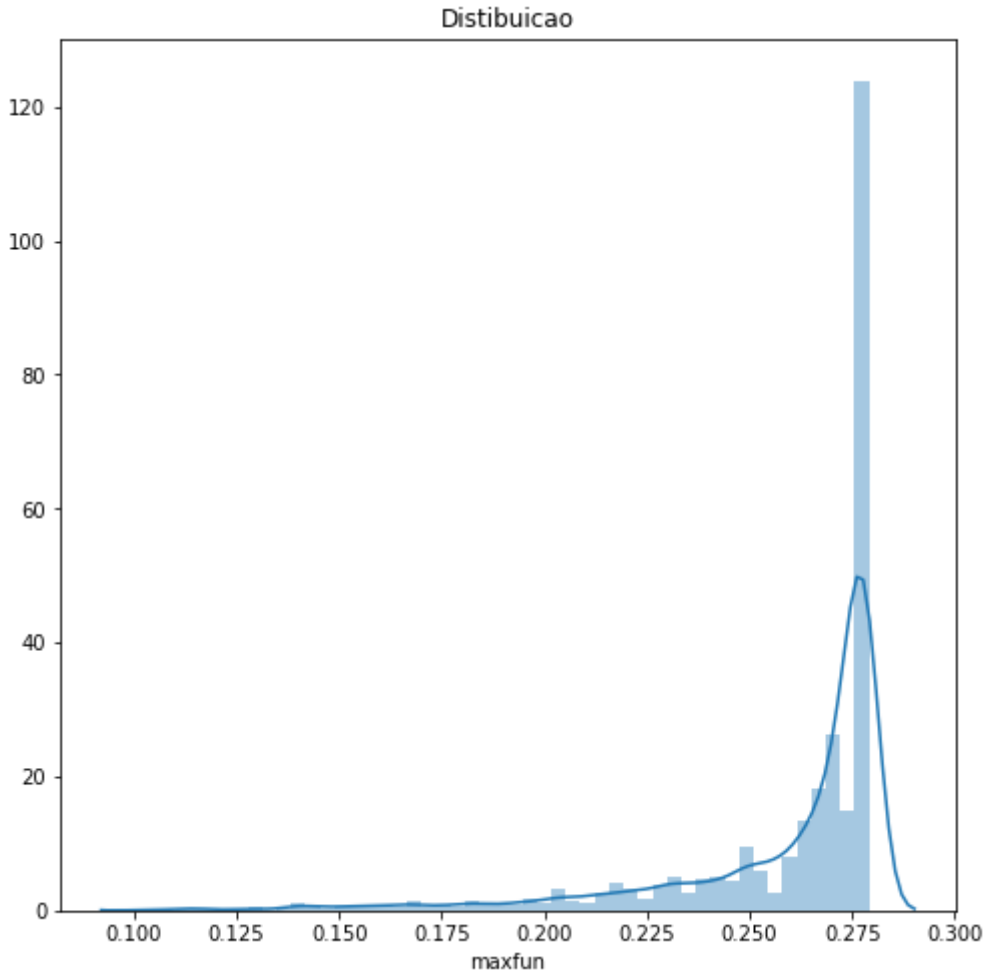

Distibuicao
2.0
1.5
1.0
0.5
0.0
0.0
0.2
0.4
0.6
0.8
1.0
sfm

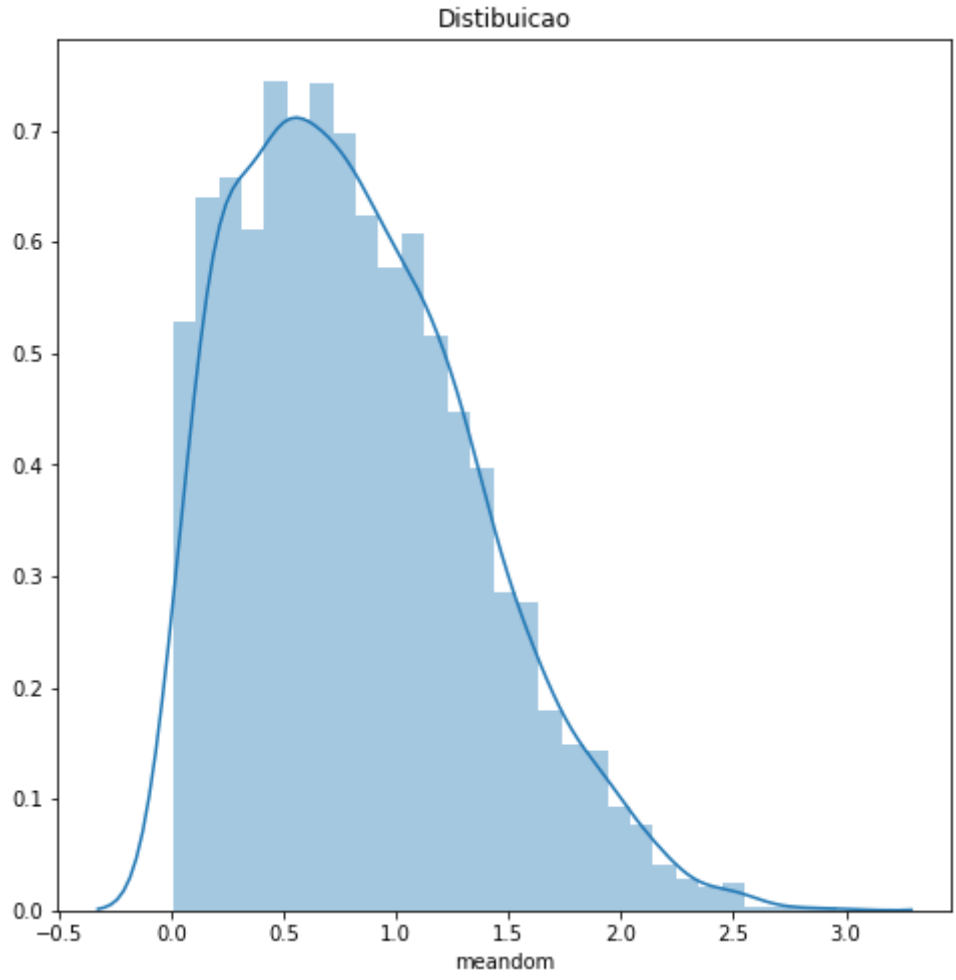

Distibuicao
8
7
6
5
4
3
2
1
0
−0.05
0.00
0.05
0.10
0.15
0.20
0.25
0.30
mode

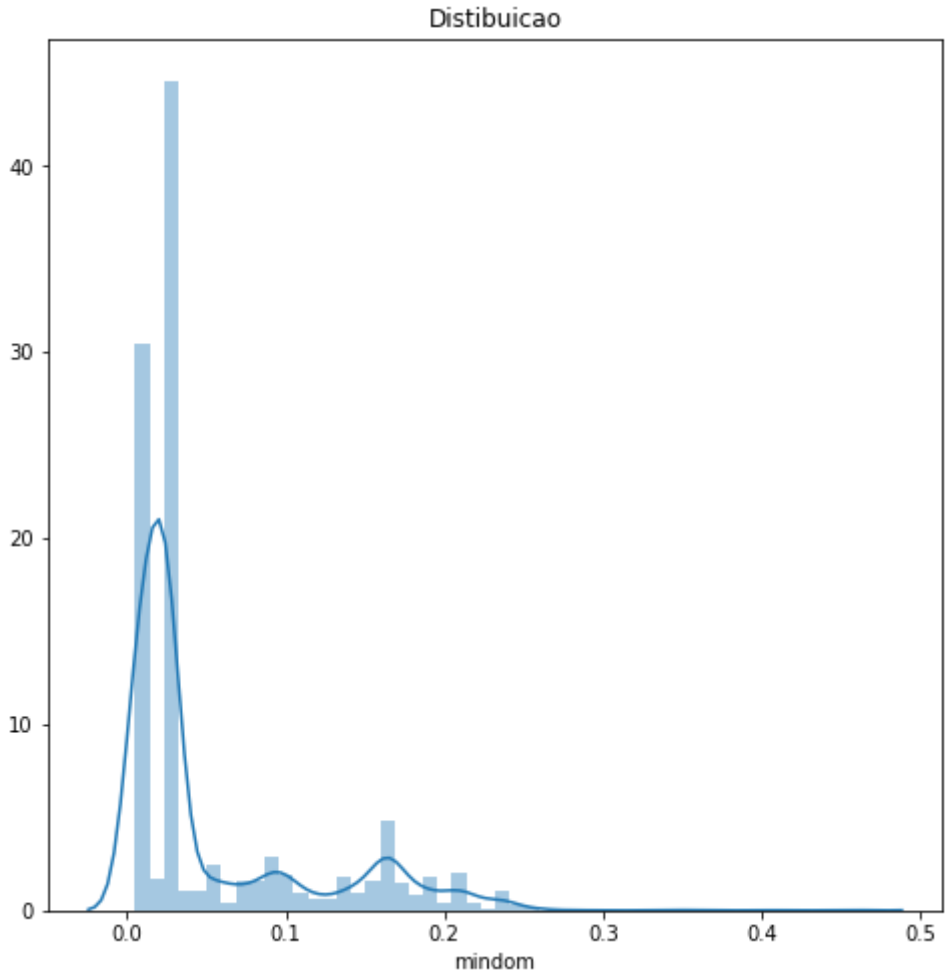

Distibuicao
17.5
15.0
12.5
10.0
7.5
5.0
2.5
0.0
0.05
0.10
0.15
0.20
0.25
centroid

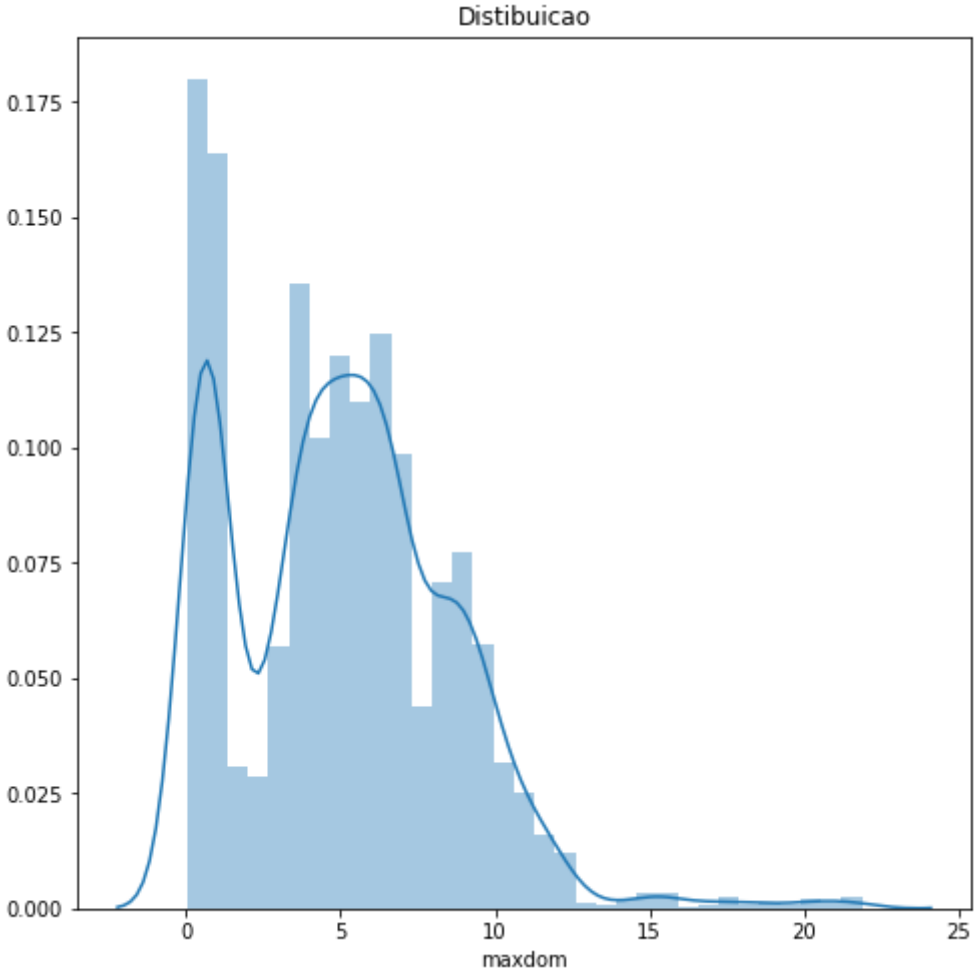

Distibuicao
12
10
8
6
4
2
0
0.05
0.10
0.15
0.20
0.25
meanfun

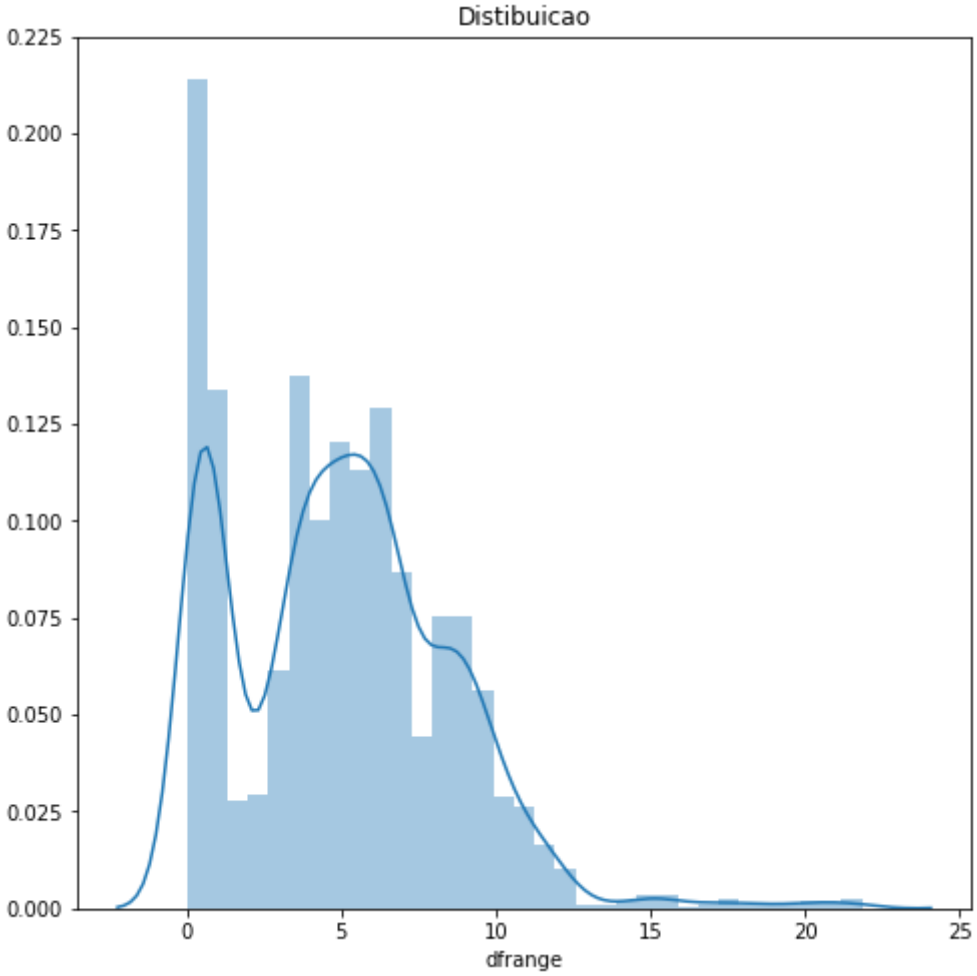

Distibuicao
80
60
40
20
0
0.00
0.05
0.10
0.15
0.20
minfun

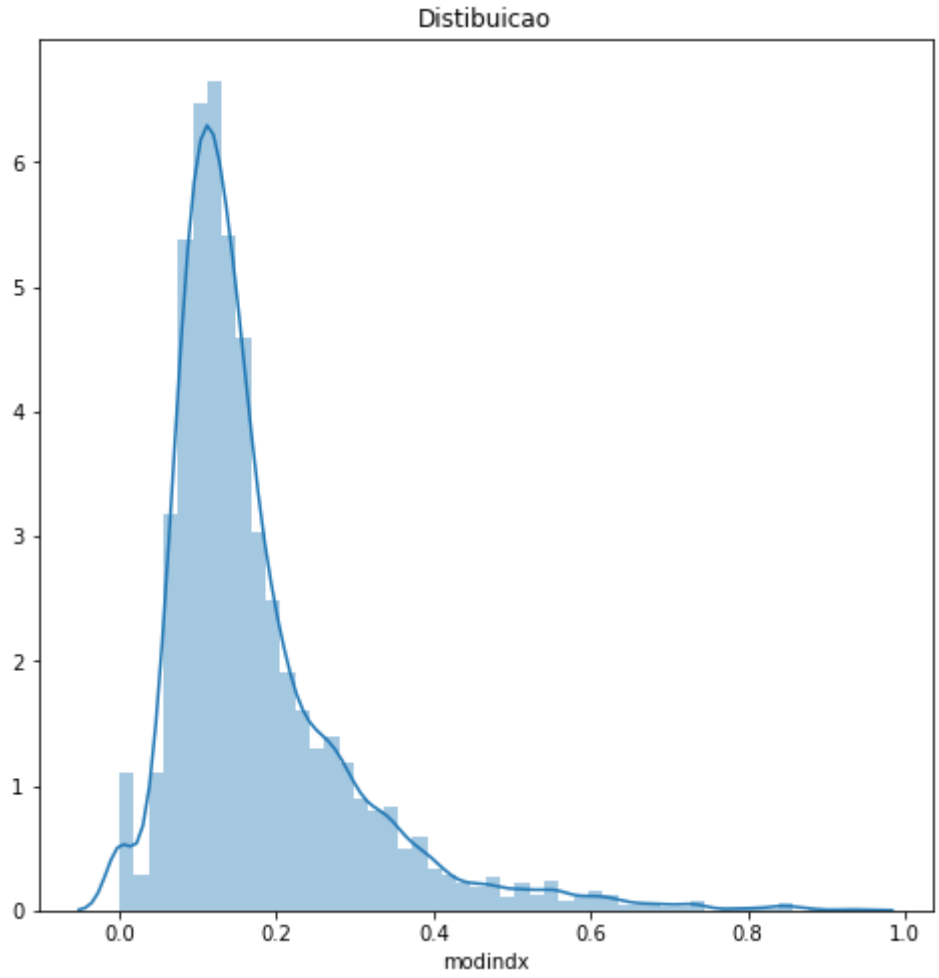

Distibuicao
120
100
80
60
40
20
0
0.100
0.125
0.150
0.175
0.200
0.225
0.250
0.275
0.300
maxfun


Distibuicao
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0.0
−0.5
0.0
0.5
1.0
1.5
2.0
2.5
3.0
meandom


Distibuicao
40
30
20
10
0
0.0
0.1
0.2
0.3
0.4
0.5
mindom


Distibuicao
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0
5
10
15
20
25
maxdom

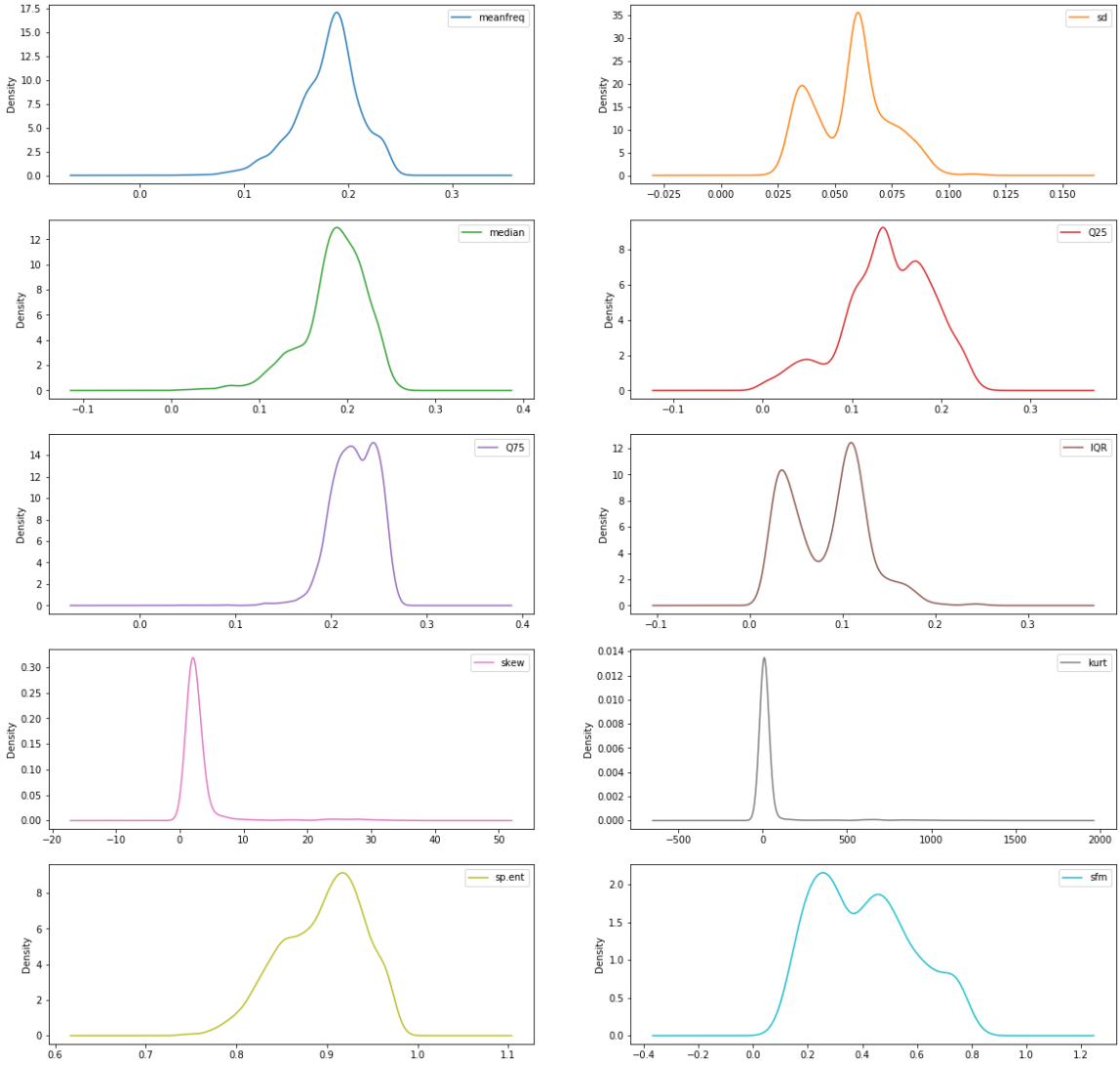

Distibuicao
0.225
0.200
0.175
0.150
0.125
0.100
0.075
0.050
0.025
0.000
0
5
10
15
20
25
dfrange



MATPLOTLIB: Gráfico de densidade (univariado)

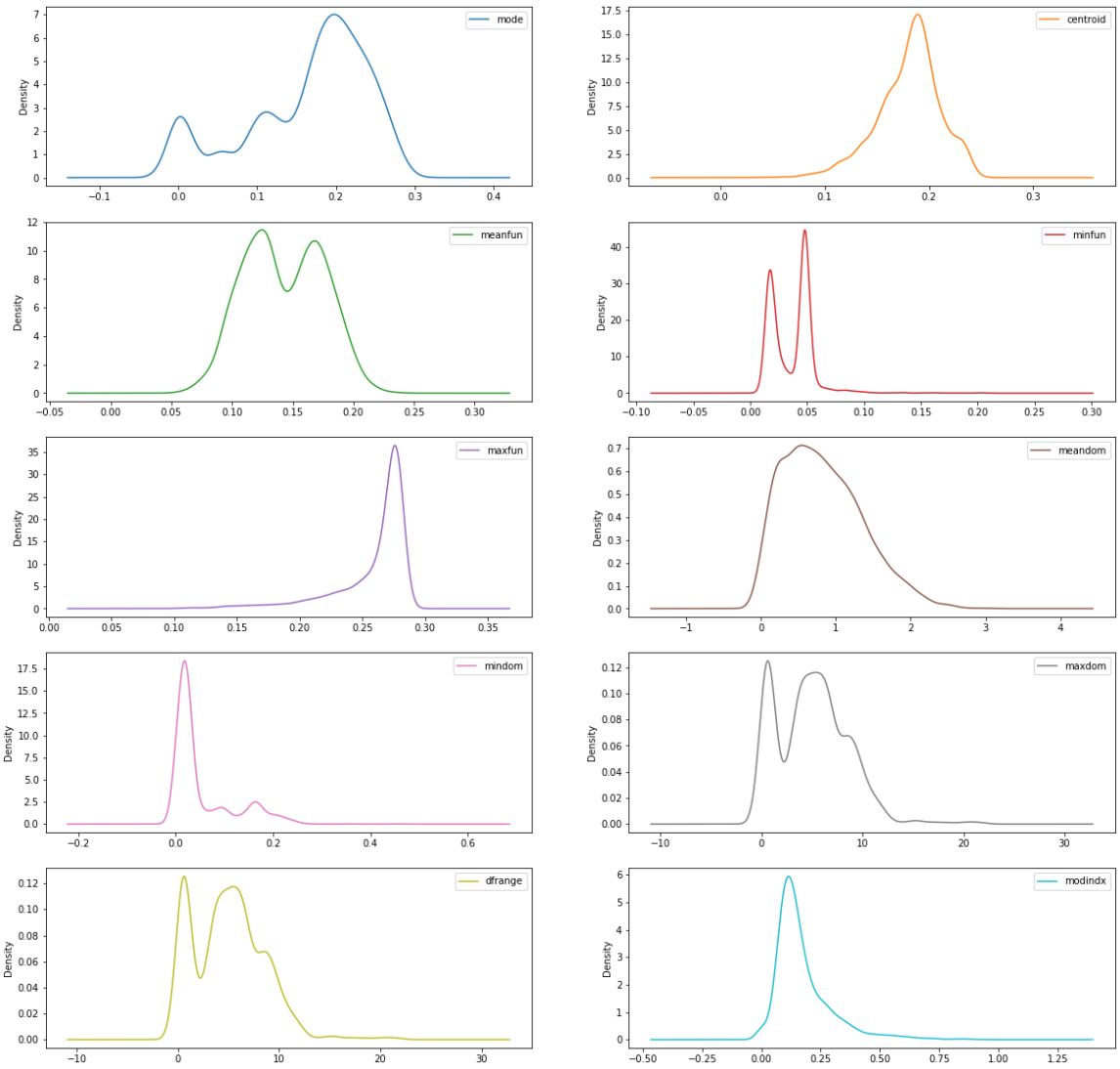
In [72]:

```
plt.rcParams['figure.figsize'] = (20,20)
dataset[colunas[0:10]].plot(kind='density', subplots=True, layout=(5,2), sharex=False)
plt.show()
```



In [73]:

```
# MATPLOTLIB: Gráfico de densidade (univariado)
plt.rcParams['figure.figsize'] = (20,20)
dataset[colunas[10:20]].plot(kind='density', subplots=True, layout=(5,2), sharex=False)
plt.show()
```



Calculando a curtose não-tendenciosa sobre o eixo solicitado usando a definição de curtose de Fisher (curtose de normal == 0,0). Normalizado por N-1:

A medida de curtose pode ser calculada da seguinte maneira:

k = \frac{\mu4}{\sigma^{4}}

De acordo com esta medida temos a seguinte classificação:

- k < 0, distribuição Platicúrtica
- k = 0, distribuição Mesocúrtica
- k > 0, distribuição Leptocúrtica

Fonte: Ferreira, D. F. Estatística Básica. Ed. UFLA, 2005. 664 p.

In [74]:

```
dataset.kurtosis()
```

Out[74]:

```
meanfreq     0.805
sd          -0.522
median       1.630
Q25          0.018
Q75          2.982
IQR         -0.448
skew        25.363
kurt        35.932
sp.ent      -0.424
sfm         -0.836
mode        -0.256
centroid     0.805
meanfun     -0.860
minfun      10.758
maxfun       5.204
meandom     -0.055
mindom       2.188
maxdom       1.315
dfrange      1.318
modindx      5.925
dtype: float64
```

Interpretação: A assimetria da variável *meanfun* é 0.039. Este valor implica que a distribuição dos dados é levemente assimétrica a direita ou positivamente assimétrica. É assimétrica a direita, pois o coeficiente é positivo, e levemente, pois está próximo de zero. Para a curtose, o valor é -0.860, implicando que a distribuição dos dados é Platicúrtica, pois o valor de curtose é menor que 0.

https://biostatistics-uem.github.io/Bio/figuras/curtose.png (https://biostatistics-uem.github.io/Bio/figuras/curtose.png)

Classifcações das distribuiçoes.

In [75]:

```
skew = dataset.skew()
curtose=dataset.kurtosis()
type(skew)
```

Out[75]:

```
pandas.core.series.Series
```

Classifcações do tipo de curtose.

In [76]:

```
srcurtose = curtose.to_dict()
for x in srcurtose:
    Z = srcurtose[x]
    if Z > 0:
        srcurtose[x] = 'Leptocúrtica'
    if Z < 0:
        srcurtose[x] = 'Platicúrtica'
    if Z == 0:
        srcurtose[x] = 'Mesocúrtica'
```

Classifcações do tipo de Assimetria.

Se As=0, distribuição é simétrica Se As>0, distribuição assimétrica a direita (positiva) Se As<0, distribuição assimétrica a esquerda (negativa) Fonte: Ferreira, D. F. Estatística Básica. Ed. UFLA, 2005. 664 p.

In [77]:

```
srskew = skew.to_dict()
for x in srskew:
    Z = srskew[x]
    if Z > 0:
        srskew[x] = 'Assimétrica a direita'
    if Z < 0:
        srskew[x] = 'Assimétrica a esquerda'
    if Z == 0:
        srskew[x] = 'Simétrica'
```

In [78]:

```
frame = { 'Assimetria': skew, 'Curtose': curtose , 'CurtoseDescricao': srcurtose, 'Assi
metriaCurtoseDescricao': srskew}
result = pandas.DataFrame(frame)
print(result)
result
```

```
          Assimetria  Curtose CurtoseDescricao AssimetriaCurtoseDescricao
IQR            0.295   -0.448     Platicúrtica      Assimétrica a direita
Q25           -0.491    0.018     Leptocúrtica     Assimétrica a esquerda
Q75           -0.900    2.982     Leptocúrtica     Assimétrica a esquerda
centroid      -0.617    0.805     Leptocúrtica     Assimétrica a esquerda
dfrange        0.728    1.318     Leptocúrtica      Assimétrica a direita
kurt           5.873   35.932     Leptocúrtica      Assimétrica a direita
maxdom         0.726    1.315     Leptocúrtica      Assimétrica a direita
maxfun        -2.239    5.204     Leptocúrtica     Assimétrica a esquerda
meandom        0.611   -0.055     Platicúrtica      Assimétrica a direita
meanfreq      -0.617    0.805     Leptocúrtica     Assimétrica a esquerda
meanfun        0.039   -0.860     Platicúrtica      Assimétrica a direita
median        -1.013    1.630     Leptocúrtica     Assimétrica a esquerda
mindom         1.661    2.188     Leptocúrtica      Assimétrica a direita
minfun         1.878   10.758     Leptocúrtica      Assimétrica a direita
mode          -0.837   -0.256     Platicúrtica     Assimétrica a esquerda
modindx        2.064    5.925     Leptocúrtica      Assimétrica a direita
sd             0.137   -0.522     Platicúrtica      Assimétrica a direita
sfm            0.340   -0.836     Platicúrtica      Assimétrica a direita
skew           4.933   25.363     Leptocúrtica      Assimétrica a direita
sp.ent        -0.431   -0.424     Platicúrtica     Assimétrica a esquerda
```

Out[78]:

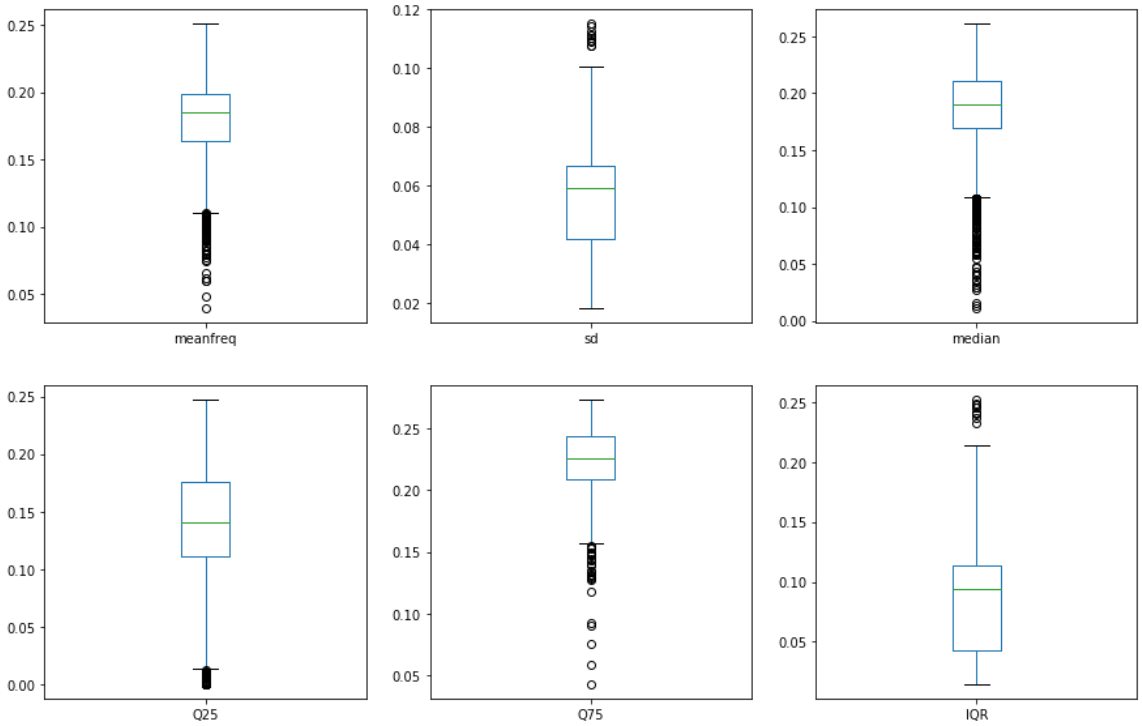
	Assimetria	Curtose	CurtoseDescricao	AssimetriaCurtoseDescricao
IQR	0.295	-0.448	Platicúrtica	Assimétrica a direita
Q25	-0.491	0.018	Leptocúrtica	Assimétrica a esquerda
Q75	-0.900	2.982	Leptocúrtica	Assimétrica a esquerda
centroid	-0.617	0.805	Leptocúrtica	Assimétrica a esquerda
dfrange	0.728	1.318	Leptocúrtica	Assimétrica a direita
kurt	5.873	35.932	Leptocúrtica	Assimétrica a direita
maxdom	0.726	1.315	Leptocúrtica	Assimétrica a direita
maxfun	-2.239	5.204	Leptocúrtica	Assimétrica a esquerda
meandom	0.611	-0.055	Platicúrtica	Assimétrica a direita
meanfreq	-0.617	0.805	Leptocúrtica	Assimétrica a esquerda
meanfun	0.039	-0.860	Platicúrtica	Assimétrica a direita
median	-1.013	1.630	Leptocúrtica	Assimétrica a esquerda
mindom	1.661	2.188	Leptocúrtica	Assimétrica a direita
minfun	1.878	10.758	Leptocúrtica	Assimétrica a direita
mode	-0.837	-0.256	Platicúrtica	Assimétrica a esquerda
modindx	2.064	5.925	Leptocúrtica	Assimétrica a direita
sd	0.137	-0.522	Platicúrtica	Assimétrica a direita
sfm	0.340	-0.836	Platicúrtica	Assimétrica a direita
skew	4.933	25.363	Leptocúrtica	Assimétrica a direita
sp.ent	-0.431	-0.424	Platicúrtica	Assimétrica a esquerda

Boxplot

O BOXPLOT representa os dados através de um retângulo construído com os quartis e fornece informação sobre valores extremos.

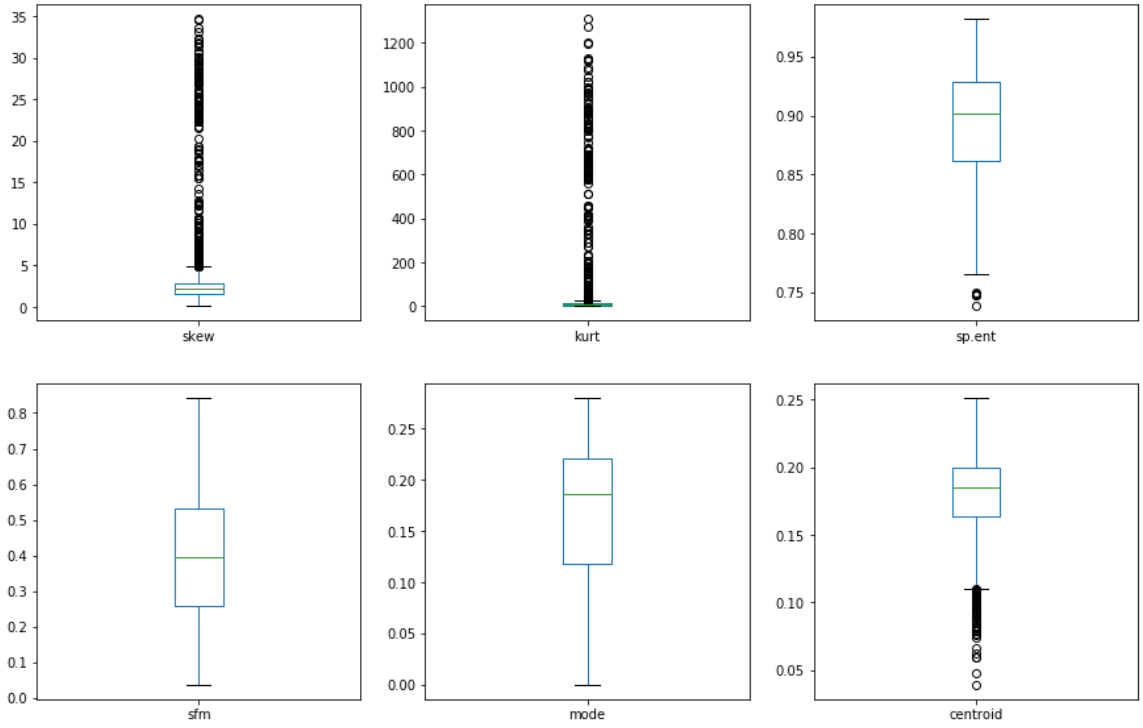
In [79]:

```
plt.rcParams['figure.figsize'] = (15,15)
dataset[colunas[0:6]].plot(kind='box', subplots=True, layout=(3,3), sharex=False, share
y=False)
plt.show()
```



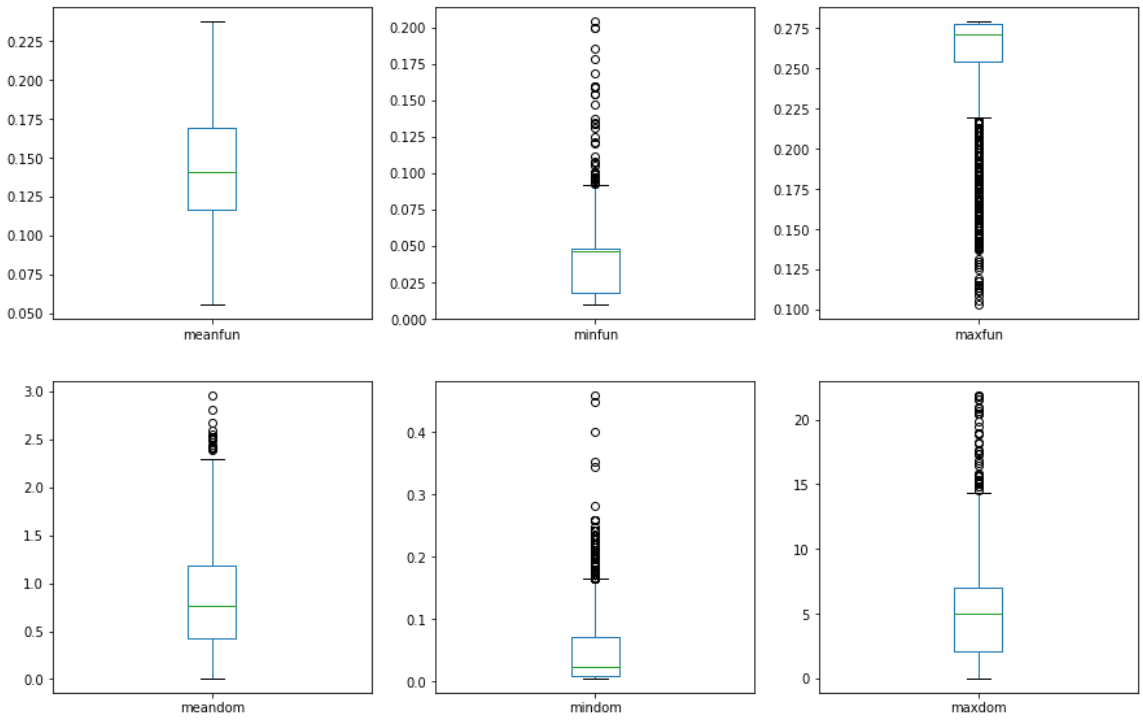
In [80]:

```
plt.rcParams['figure.figsize'] = (15,15)
dataset[colunas[6:6 * 2]].plot(kind='box', subplots=True, layout=(3,3), sharex=False, s
harey=False)
plt.show()
```



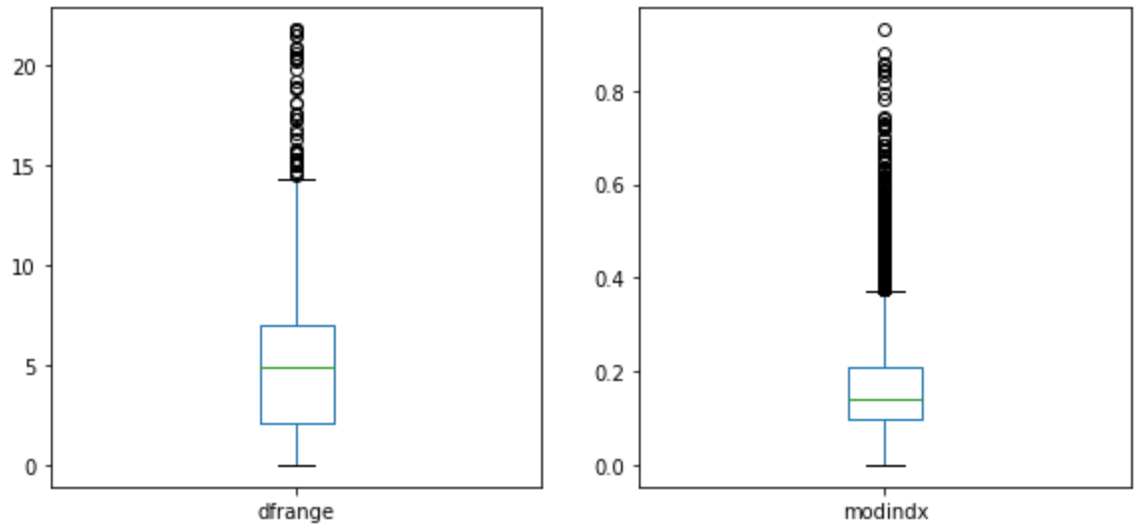
In [81]:

```
plt.rcParams['figure.figsize'] = (15,15)
dataset[colunas[6 *2 :6 * 3]].plot(kind='box', subplots=True, layout=(3,3), sharex=Fals
e, sharey=False)
plt.show()
```



In [82]:

```
plt.rcParams['figure.figsize'] = (15,15)
dataset[colunas[6 *3 :6 * 4]].plot(kind='box', subplots=True, layout=(3,3), sharex=Fals
e, sharey=False)
plt.show()
```



Resultado Boxplot, verificamos a incidência de Observação exterior (discrepante ou atípica).

Esses dados serão tratados utilizando o desvio padrão: calculando o skewness: skewness = 3(média – mediana) / desvio padrão

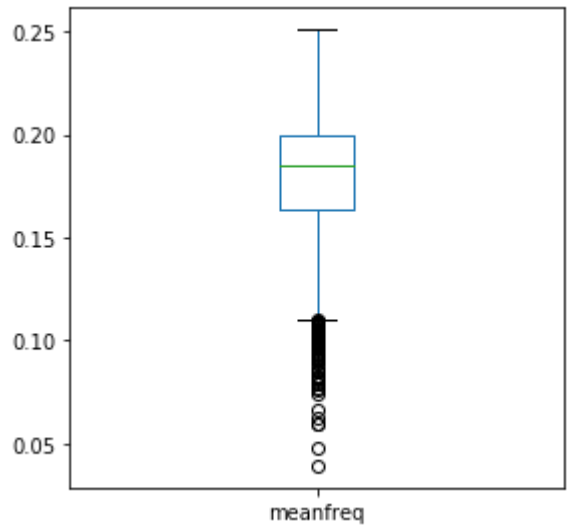
In [83]:

```
# Carrega os dados
url = ".\\baseDados\\voice.csv"
colunas = ["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","sfm","mod
e","centroid","meanfun","minfun","maxfun","meandom","mindom","maxdom","dfrange","modind
x","label"]
dataset = pandas.read_csv(url, names=colunas, sep = ",")
```

Primeiro caso.

In [84]:

```
plt.rcParams['figure.figsize'] = (15,15)
dataset[colunas[0]].plot(kind='box', subplots=True, layout=(3,3), sharex=False, sharey=
False)
plt.show()
dataset[colunas[0]].shape
```



Out[84]:

```
(3168,)
```

Esses dados serão tratados utilizando o desvio padrão:

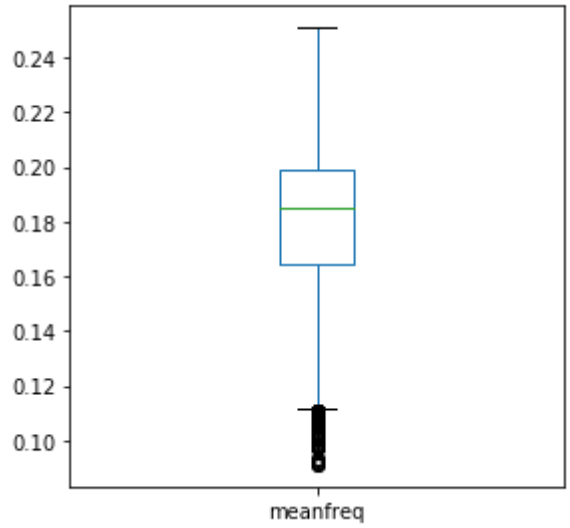
calculando o skewness: skewness = 3(média – mediana) / desvio padrão

In [85]:

```
df_sem_Outliers= dataset[ numpy.abs(dataset[colunas[0]] - dataset[colunas[0]].mean() )
<=  ( 3*dataset[colunas[0]].std()) ]
```

In [86]:

```
plt.rcParams['figure.figsize'] = (15,15)
df_sem_Outliers[colunas[0]].plot(kind='box', subplots=True, layout=(3,3), sharex=False,
sharey=False)
plt.show()
df_sem_Outliers[colunas[0]].shape
```



Out[86]:

```
(3145,)
```

Possui ainda muitos ou valores discrepantes vamos o método de interquartil.

Definição da Wikipedia A gama interquartil (IQR), também chamado o midspread ou meio de 50% , ou tecnicamente H-propagação , é uma medida da dispersão estatística, sendo igual à diferença entre os percentis 75 e 25 de, ou entre os quartis superiores e inferiores, IQR = Q 3 - Q 1. Em outras palavras, o IQR é o primeiro quartil subtraído do terceiro quartil; esses quartis podem ser vistos claramente em um gráfico de caixa nos dados. É uma medida da dispersão semelhante ao desvio ou variância padrão, mas é muito mais robusta contra valores extremos.

In [87]:

```
Q1 = dataset[colunas[0]].quantile(0.25)
Q3 = dataset[colunas[0]].quantile(0.75)
IQR = Q3 - Q1
```

In [88]:

```
df_sem_Outliersx = dataset[colunas[0]][~((dataset[colunas[0]] < (Q1 - 1.5 * IQR)) | (da
taset[colunas[0]]> (Q3 + 1.5 * IQR)))]
dataset[colunas[0]] = df_sem_Outliersx
dataset.head()
```

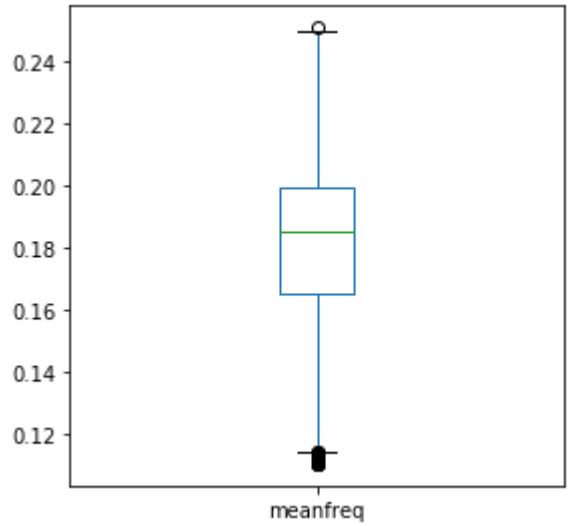
Out[88]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt	sp.ent	sfm	...	centro
0	NaN	0.064	0.032	0.015	0.090	0.075	12.863	274.403	0.893	0.492	...	0.0(
1	NaN	0.067	0.040	0.019	0.093	0.073	22.423	634.614	0.892	0.514	...	0.0(
2	NaN	0.084	0.037	0.009	0.132	0.123	30.757	1024.928	0.846	0.479	...	0.0
3	0.151	0.072	0.158	0.097	0.208	0.111	1.233	4.177	0.963	0.727	...	0.1
4	0.135	0.079	0.125	0.079	0.206	0.127	1.101	4.334	0.972	0.784	...	0.1

5 rows × 21 columns

In [89]:

```
plt.rcParams['figure.figsize'] = (15,15)
df_sem_Outliersx.plot(kind='box', subplots=True, layout=(3,3), sharex=False, sharey=Fal
se)
plt.show()
df_sem_Outliersx.shape
```



Out[89]:

```
(3104,)
```

Resultado melhorou com a técnica interquartil.

Fazendo nas todas variaveis por N vezes

In [90]:

```
dfgrafico_test = dataset
NV=6
for z in range(0,NV):
    for y in colunas:
        if y == "label":
            continue
        Q1 = dfgrafico_test[y].quantile(0.25)
        Q3 = dfgrafico_test[y].quantile(0.75)
        IQR = Q3 - Q1
        df_sem_Outliersx = dfgrafico_test[y][~((dfgrafico_test[y] < (Q1 - 1.5 * IQR)) |
(dfgrafico_test[y]> (Q3 + 1.5 * IQR)))]
        dfgrafico_test[y] = df_sem_Outliersx


dfgrafico_test = dataset
for z in range(0,NV):
    for y in colunas:
        if y == "label":
            continue
        Q1 = dataset[y].quantile(0.25)
        Q3 = dataset[y].quantile(0.75)
        IQR = Q3 - Q1
        df_sem_Outliersx = dataset[y][~((dataset[y] < (Q1 - 1.5 * IQR)) | (dataset[y]>
(Q3 + 1.5 * IQR)))]
        dataset[y] = df_sem_Outliersx
        dataset=dataset.fillna(dataset.mean())
```

Valores discrepantes Foram removidos da base

In [91]:

```
dfgrafico_test.head()
```

Out[91]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt	sp.ent	sfm	...	centroid
0	NaN	0.064	NaN	NaN	NaN	0.075	NaN	NaN	0.893	0.492	...	NaN
1	NaN	0.067	NaN	0.019	NaN	0.073	NaN	NaN	0.892	0.514	...	NaN
2	NaN	0.084	NaN	NaN	NaN	0.123	NaN	NaN	0.846	0.479	...	NaN
3	0.151	0.072	0.158	0.097	0.208	0.111	1.233	4.177	0.963	0.727	...	0.151
4	0.135	0.079	0.125	0.079	0.206	0.127	1.101	4.334	0.972	0.784	...	0.135

5 rows × 21 columns

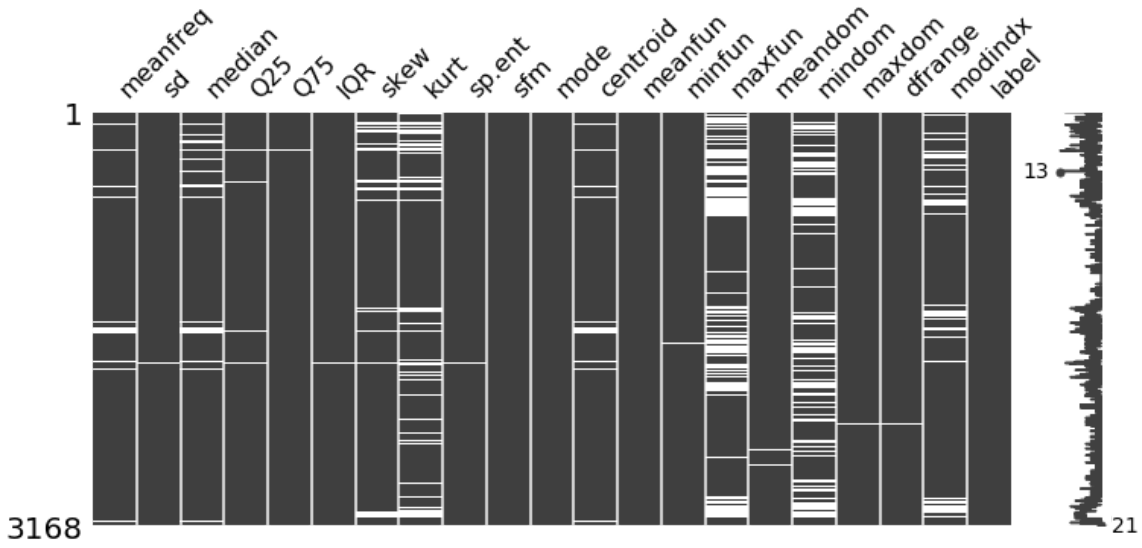
Analizando o grafio novamente de valorer faltantes antes de aplicar a media

In [92]:

```
msno.matrix(dfgrafico_test,figsize=(12,5))
```

Out[92]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x16136ed0>
```



In [93]:

```
dfgrafico_test.isnull().sum()
```

Out[93]:

```
meanfreq    100
sd           10
median      157
Q25          43
Q75          28
IQR          10
skew        253
kurt        446
sp.ent        6
sfm           0
mode          0
centroid    100
meanfun       0
minfun       38
maxfun      972
meandom      20
mindom      902
maxdom       42
dfrange      42
modindx     411
label         0
dtype: int64
```

In [94]:

```
dataset = dataset.dropna()
print(dataset.shape)
```

```
(3168, 21)
```

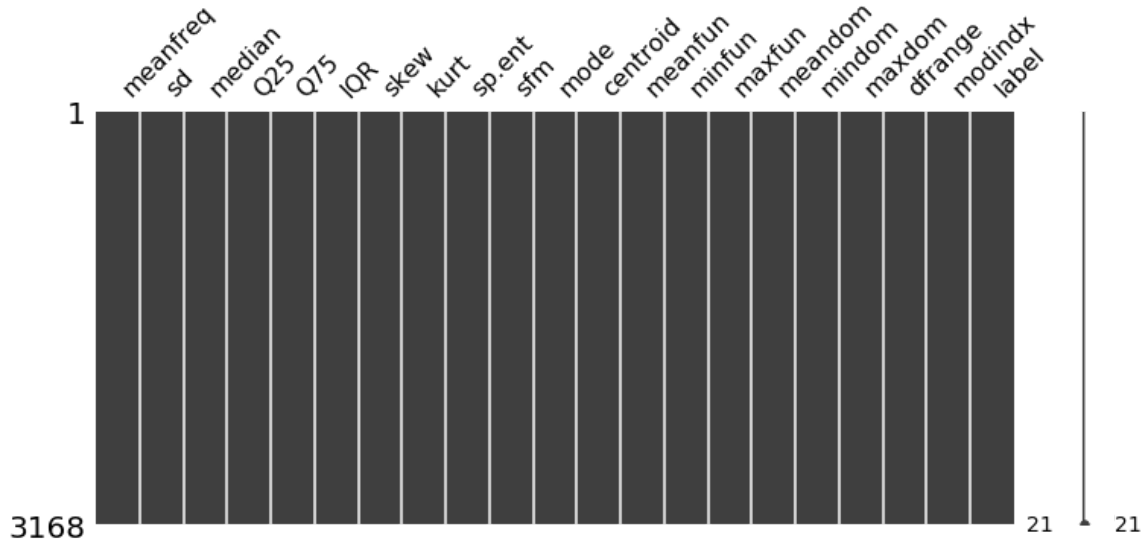
Analizando o grafio do dataset aplicado a media nos valores faltantes.

In [95]:

```
msno.matrix(dataset,figsize=(12,5))
```

Out[95]:

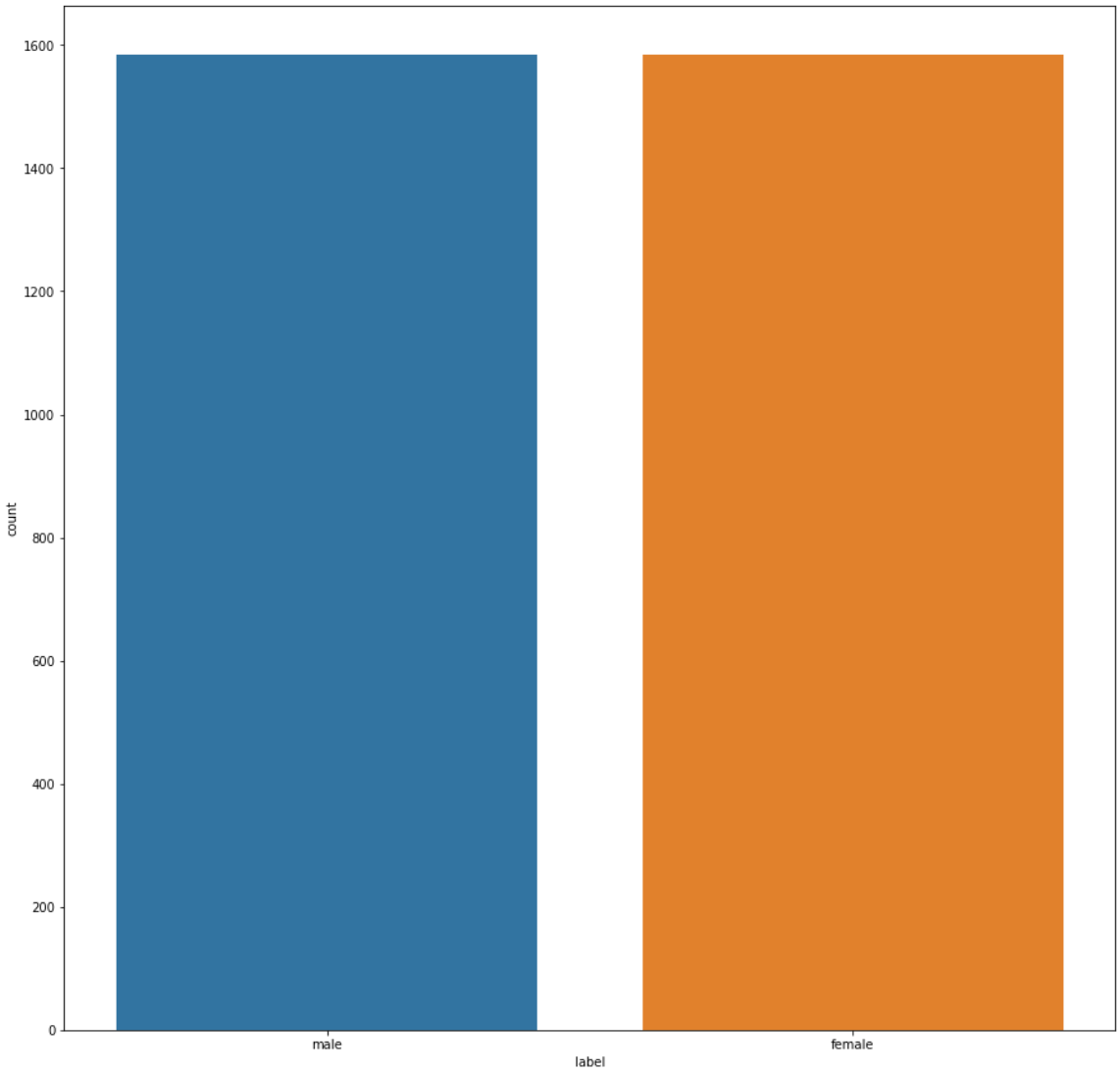
```
<matplotlib.axes._subplots.AxesSubplot at 0x137c4550>
```



Recalcular as classe qualitativas

In [96]:

```
sb.countplot('label',data=dataset)
plt.rcParams['figure.figsize'] = (10,5)
plt.show()
```



In [97]:

```
contagem = dataset.groupby('label').size()
print(contagem)
```

```
label
female    1584
male      1584
dtype: int64
```

In [98]:

```
total=contagem[['female']][0] + contagem[['male']][0]
```

Calculando a frequência relativa. fr =fi / n ou seja contagem por classe sobre total somada dos valores de cada classe.

In [99]:

```
freqFRsexodic={}
freqFRsexodic['female']=   contagem[['female']][0] / total
freqFRsexodic['male']=    contagem[['male']][0] / total
freqFRsexodic['Total']=   (  contagem[['female']][0] / total ) + (  contagem[['male']][
0] / total)
```

Calculando a Frequência relativa percentual da categoria. fri% = fri * 100

In [100]:

```
freqFRpcsexodic={}
freqFRpcsexodic['female']=   freqFRsexodic['female'] * 100
freqFRpcsexodic['male']=    freqFRsexodic['male']  * 100
freqFRpcsexodic['Total']=  freqFRsexodic['Total']  * 100
```

In [ ]:

```

```

In [101]:

```
freqsexodic={}
freqsexodic['female']=contagem[['female']][0]
freqsexodic['male']=contagem[['male']][0]
freqsexodic['Total']=total
```

Montado o dratafrane com os resultados.

In [102]:

```
dffrequenciaSexo = pandas.DataFrame.from_dict(freqsexodic, orient="index").reset_index
()
dffrequenciaSexo.columns = ["qualitivas","contagem"]
```

In [103]:

```
dffrequenciaSexoFR = pandas.DataFrame.from_dict(freqFRsexodic, orient="index").reset_in
dex()
dffrequenciaSexoFR.columns = ["qualitivas","freqRelativa"]
```

In [ ]:

```

```

In [104]:

```
dffrequenciaSexoFRpc = pandas.DataFrame.from_dict(freqFRpcsexodic, orient="index").rese
t_index()
dffrequenciaSexoFRpc.columns = ["qualitivas","freqRelativa%"]
```

In [105]:

```
dftabelaFreqQualitativas=pandas.merge(dffrequenciaSexo,dffrequenciaSexoFR,how='right',o
n='qualitivas')
dftabelaFreqQualitativas=pandas.merge(dftabelaFreqQualitativas,dffrequenciaSexoFRpc,how
='right',on='qualitivas')
```

In [106]:

```
dftabelaFreqQualitativas
```

Out[106]:

	qualitivas	contagem	freqRelativa	freqRelativa%
0	female	1584	0.5	50.0
1	male	1584	0.5	50.0
2	Total	3168	1.0	100.0

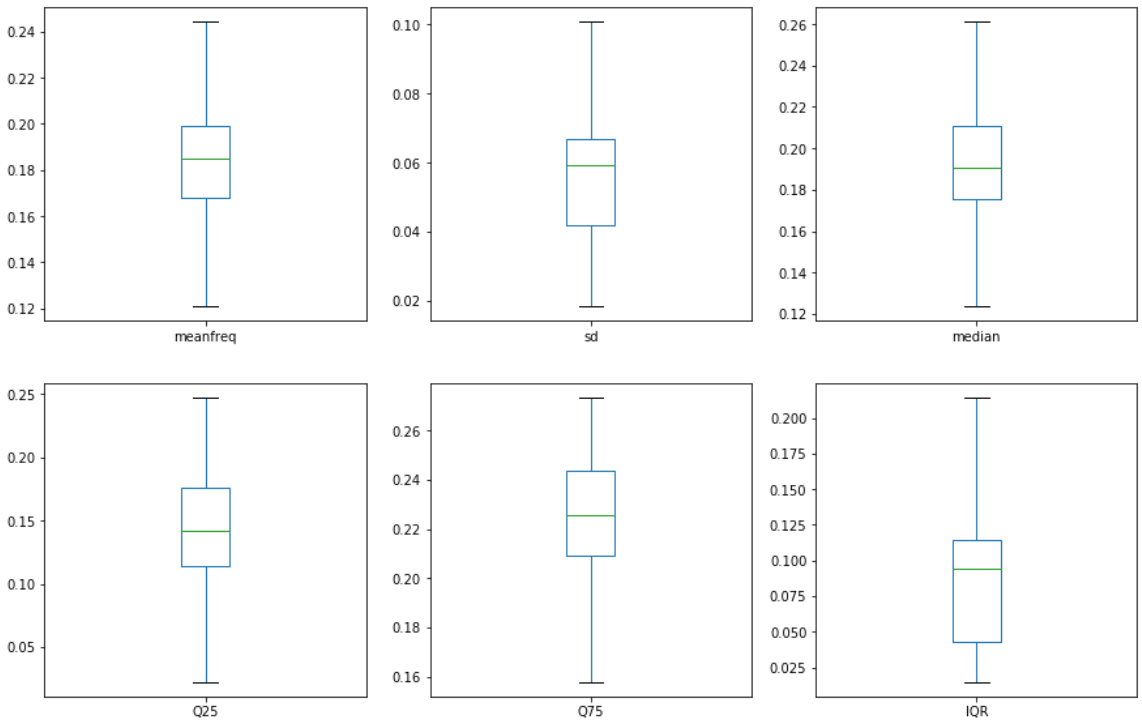
Resultado equilbrado entre homens e mulheres.

Refazendo boxplot.

O BOXPLOT representa os dados através de um retângulo construído com os quartis e fornece informação sobre valores extremos.

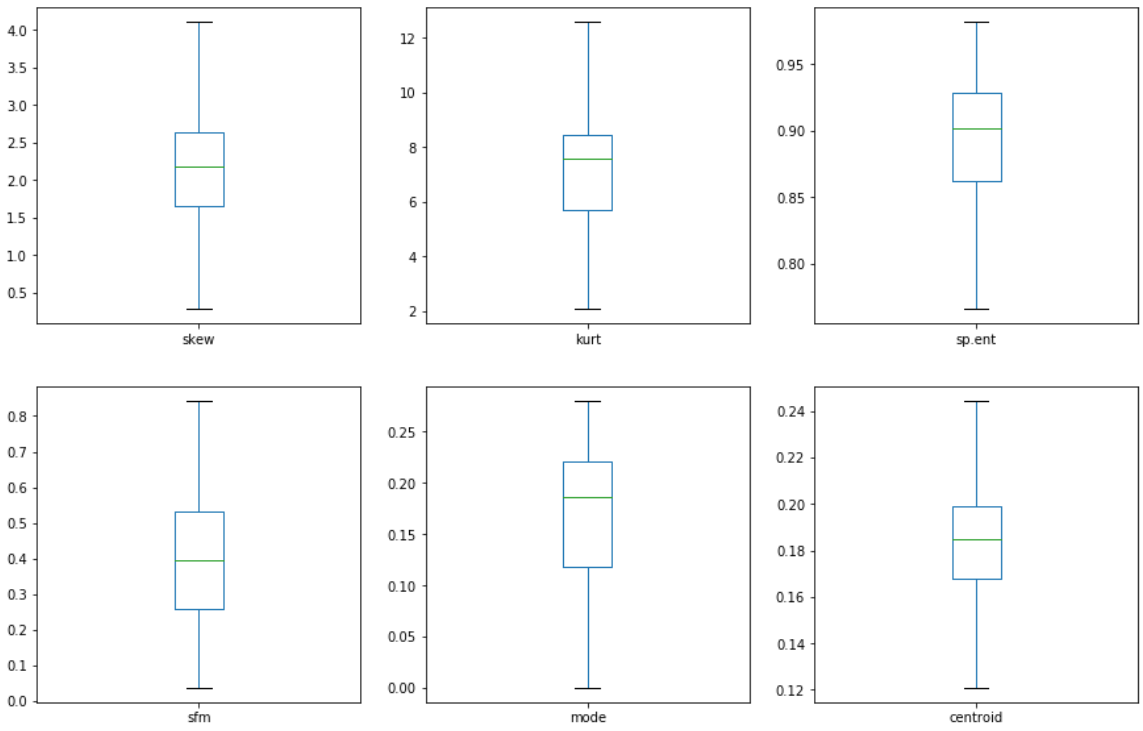
In [107]:

```
plt.rcParams['figure.figsize'] = (15,15)
dataset[colunas[0:6]].plot(kind='box', subplots=True, layout=(3,3), sharex=False, share
y=False)
plt.show()
```



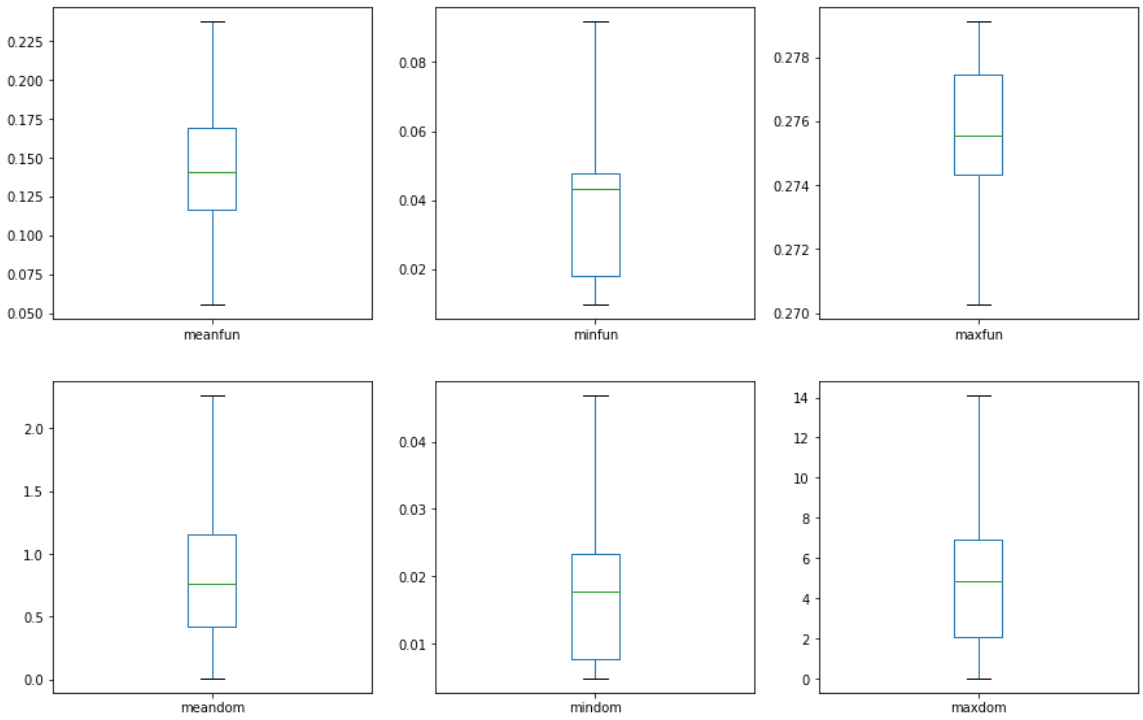
In [108]:

```
plt.rcParams['figure.figsize'] = (15,15)
dataset[colunas[6:6 * 2]].plot(kind='box', subplots=True, layout=(3,3), sharex=False, s
harey=False)
plt.show()
```



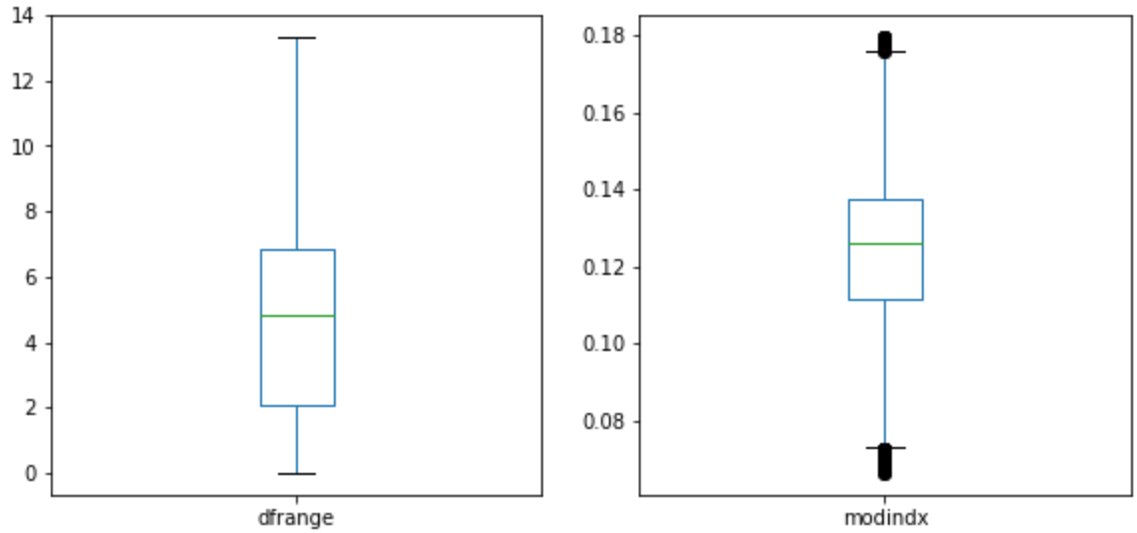
In [109]:

```
plt.rcParams['figure.figsize'] = (15,15)
dataset[colunas[6 *2 :6 * 3]].plot(kind='box', subplots=True, layout=(3,3), sharex=Fals
e, sharey=False)
plt.show()
```



In [110]:

```
plt.rcParams['figure.figsize'] = (15,15)
dataset[colunas[6 *3 :6 * 4]].plot(kind='box', subplots=True, layout=(3,3), sharex=Fals
e, sharey=False)
plt.show()
```



Dataset depois de limpo ainda possui alguns Valores discrepantes.

Analisando a correlação das variáveis.

In [111]:

```
# PANDAS: Correlação
cor = dataset.corr(method='pearson')
print(cor)
```

```
           meanfreq     sd  median    Q25    Q75    IQR   skew   kurt  sp.e
nt    sfm   mode  \
meanfreq     1.000 -0.693   0.828  0.806  0.622 -0.575  0.012 -0.036  -0.6
42 -0.771  0.573
sd          -0.693  1.000  -0.468 -0.819 -0.143  0.870 -0.227 -0.114   0.7
66  0.861 -0.516
median       0.828 -0.468   1.000  0.621  0.598 -0.379 -0.043 -0.060  -0.4
98 -0.596  0.521
Q25          0.806 -0.819   0.621  1.000  0.426 -0.856  0.221  0.119  -0.7
53 -0.805  0.535
Q75          0.622 -0.143   0.598  0.426  1.000  0.017 -0.254 -0.230  -0.1
92 -0.386  0.452
IQR         -0.575  0.870  -0.379 -0.856  0.017  1.000 -0.364 -0.239   0.6
97  0.689 -0.387
skew         0.012 -0.227  -0.043  0.221 -0.254 -0.364  1.000  0.694  -0.4
07 -0.207 -0.153
kurt        -0.036 -0.114  -0.060  0.119 -0.230 -0.239  0.694  1.000  -0.2
85 -0.101 -0.175
sp.ent      -0.642  0.766  -0.498 -0.753 -0.192  0.697 -0.407 -0.285   1.0
00  0.869 -0.340
sfm         -0.771  0.861  -0.596 -0.805 -0.386  0.689 -0.207 -0.101   0.8
69  1.000 -0.486
mode         0.573 -0.516   0.521  0.535  0.452 -0.387 -0.153 -0.175  -0.3
40 -0.486  1.000
centroid     1.000 -0.693   0.828  0.806  0.622 -0.575  0.012 -0.036  -0.6
42 -0.771  0.573
meanfun      0.500 -0.487   0.444  0.570  0.140 -0.561  0.198  0.122  -0.5
11 -0.421  0.325
minfun       0.421 -0.383   0.334  0.327  0.326 -0.208 -0.080 -0.138  -0.3
27 -0.416  0.454
maxfun       0.350 -0.227   0.302  0.267  0.327 -0.130 -0.116 -0.110  -0.1
98 -0.262  0.286
meandom      0.500 -0.463   0.389  0.427  0.355 -0.310 -0.126 -0.145  -0.2
90 -0.418  0.494
mindom       0.406 -0.386   0.331  0.367  0.309 -0.264 -0.161 -0.169  -0.2
72 -0.373  0.477
maxdom       0.516 -0.486   0.417  0.451  0.339 -0.337 -0.121 -0.122  -0.3
35 -0.442  0.498
dfrange      0.512 -0.479   0.416  0.446  0.339 -0.331 -0.127 -0.125  -0.3
29 -0.437  0.494
modindx     -0.163  0.130  -0.148 -0.123 -0.131  0.068  0.023  0.018   0.1
35  0.168 -0.129

           centroid  meanfun  minfun  maxfun  meandom  mindom  maxdom  dfra
nge  modindx
meanfreq     1.000    0.500   0.421   0.350    0.500   0.406   0.516    0.
512   -0.163
sd          -0.693   -0.487  -0.383  -0.227   -0.463  -0.386  -0.486   -0.
479    0.130
median       0.828    0.444   0.334   0.302    0.389   0.331   0.417    0.
416   -0.148
Q25          0.806    0.570   0.327   0.267    0.427   0.367   0.451    0.
446   -0.123
Q75          0.622    0.140   0.326   0.327    0.355   0.309   0.339    0.
339   -0.131
IQR         -0.575   -0.561  -0.208  -0.130   -0.310  -0.264  -0.337   -0.
331    0.068
skew         0.012    0.198  -0.080  -0.116   -0.126  -0.161  -0.121   -0.
127    0.023
kurt        -0.036    0.122  -0.138  -0.110   -0.145  -0.169  -0.122   -0.
125    0.018
```

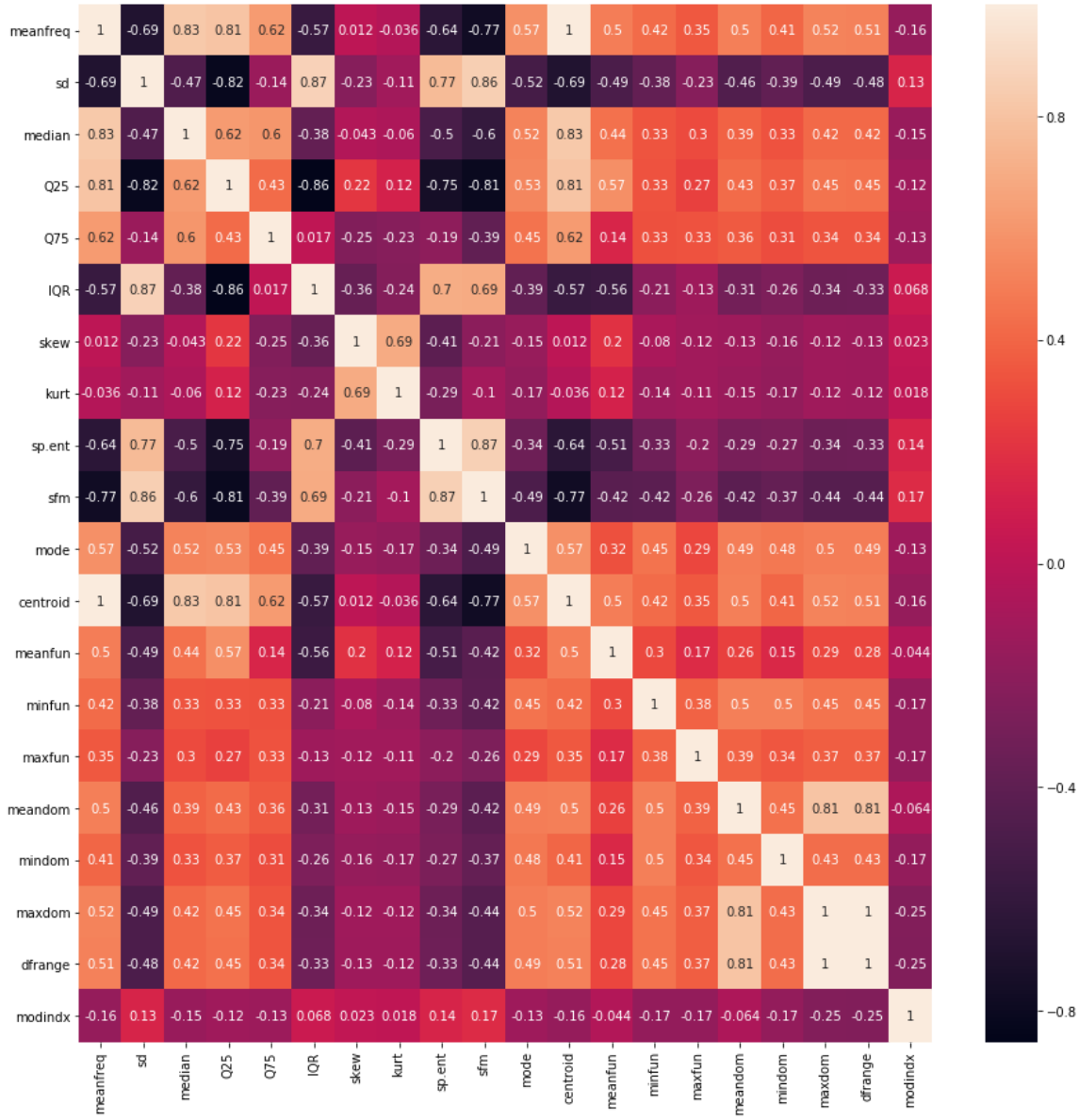
```
sp.ent      -0.642   -0.511  -0.327  -0.198   -0.290  -0.272  -0.335   -0.
329    0.135
sfm         -0.771   -0.421  -0.416  -0.262   -0.418  -0.373  -0.442   -0.
437    0.168
mode         0.573    0.325   0.454   0.286    0.494   0.477   0.498    0.
494   -0.129
centroid     1.000    0.500   0.421   0.350    0.500   0.406   0.516    0.
512   -0.163
meanfun      0.500    1.000   0.296   0.169    0.265   0.155   0.286    0.
284   -0.044
minfun       0.421    0.296   1.000   0.384    0.500   0.503   0.451    0.
451   -0.173
maxfun       0.350    0.169   0.384   1.000    0.387   0.341   0.371    0.
374   -0.173
meandom      0.500    0.265   0.500   0.387    1.000   0.449   0.811    0.
808   -0.064
mindom       0.406    0.155   0.503   0.341    0.449   1.000   0.430    0.
428   -0.170
maxdom       0.516    0.286   0.451   0.371    0.811   0.430   1.000    0.
997   -0.247
dfrange      0.512    0.284   0.451   0.374    0.808   0.428   0.997    1.
000   -0.247
modindx     -0.163   -0.044  -0.173  -0.173   -0.064  -0.170  -0.247   -0.
247    1.000
```

In [112]:

```
sb.heatmap(cor, annot = True)
```

Out[112]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x164384b0>
```


meanfreq 1 -0.69 0.83 0.81 0.62 -0.57 0.012 -0.036 -0.64 -0.77 0.57 1 0.5 0.42 0.35 0.5 0.41 0.52 0.51 -0.16
sd -0.69 1 -0.47 -0.82 -0.14 0.87 -0.23 -0.11 0.77 0.86 -0.52 -0.69 -0.49 -0.38 -0.23 -0.46 -0.39 -0.49 -0.48 0.13
median 0.83 -0.47 1 0.62 0.6 -0.38 -0.043 -0.06 -0.5 -0.6 0.52 0.83 0.44 0.33 0.3 0.39 0.33 0.42 0.42 -0.15
Q25 0.81 -0.82 0.62 1 0.43 -0.86 0.22 0.12 -0.75 -0.81 0.53 0.81 0.57 0.33 0.27 0.43 0.37 0.45 0.45 -0.12
Q75 0.62 -0.14 0.6 0.43 1 0.017 -0.25 -0.23 -0.19 -0.39 0.45 0.62 0.14 0.33 0.33 0.36 0.31 0.34 0.34 -0.13
IQR -0.57 0.87 -0.38 -0.86 0.017 1 -0.36 -0.24 0.7 0.69 -0.39 -0.57 -0.56 -0.21 -0.13 -0.31 -0.26 -0.34 -0.33 0.068
skew 0.012 -0.23 -0.043 0.22 -0.25 -0.36 1 0.69 -0.41 -0.21 -0.15 0.012 0.2 -0.08 -0.12 -0.13 -0.16 -0.12 -0.13 0.023
kurt -0.036 -0.11 -0.06 0.12 -0.23 -0.24 0.69 1 -0.29 -0.1 -0.17 -0.036 0.12 -0.14 -0.11 -0.15 -0.17 -0.12 -0.12 0.018
sp.ent -0.64 0.77 -0.5 -0.75 -0.19 0.7 -0.41 -0.29 1 0.87 -0.34 -0.64 -0.51 -0.33 -0.2 -0.29 -0.27 -0.34 -0.33 0.14
sfm -0.77 0.86 -0.6 -0.81 -0.39 0.69 -0.21 -0.1 0.87 1 -0.49 -0.77 -0.42 -0.42 -0.26 -0.42 -0.37 -0.44 -0.44 0.17
mode 0.57 -0.52 0.52 0.53 0.45 -0.39 -0.15 -0.17 -0.34 -0.49 1 0.57 0.32 0.45 0.29 0.49 0.48 0.5 0.49 -0.13
centroid 1 -0.69 0.83 0.81 0.62 -0.57 0.012 -0.036 -0.64 -0.77 0.57 1 0.5 0.42 0.35 0.5 0.41 0.52 0.51 -0.16
meanfun 0.5 -0.49 0.44 0.57 0.14 -0.56 0.2 0.12 -0.51 -0.42 0.32 0.5 1 0.3 0.17 0.26 0.15 0.29 0.28 -0.044
minfun 0.42 -0.38 0.33 0.33 0.33 -0.21 -0.08 -0.14 -0.33 -0.42 0.45 0.42 0.3 1 0.38 0.5 0.5 0.45 0.45 -0.17
maxfun 0.35 -0.23 0.3 0.27 0.33 -0.13 -0.12 -0.11 -0.2 -0.26 0.29 0.35 0.17 0.38 1 0.39 0.34 0.37 0.37 -0.17
meandom 0.5 -0.46 0.39 0.43 0.36 -0.31 -0.13 -0.15 -0.29 -0.42 0.49 0.5 0.26 0.5 0.39 1 0.45 0.81 0.81 -0.064
mindom 0.41 -0.39 0.33 0.37 0.31 -0.26 -0.16 -0.17 -0.27 -0.37 0.48 0.41 0.15 0.5 0.34 0.45 1 0.43 0.43 -0.17
maxdom 0.52 -0.49 0.42 0.45 0.34 -0.34 -0.12 -0.12 -0.34 -0.44 0.5 0.52 0.29 0.45 0.37 0.81 0.43 1 1 -0.25
dfrange 0.51 -0.48 0.42 0.45 0.34 -0.33 -0.13 -0.12 -0.33 -0.44 0.49 0.51 0.28 0.45 0.37 0.81 0.43 1 1 -0.25
modindx -0.16 0.13 -0.15 -0.12 -0.13 0.068 0.023 0.018 0.14 0.17 -0.13 -0.16 -0.044 -0.17 -0.17 -0.064 -0.17 -0.25 -0.25 1
meanfreq sd median Q25 Q75 IQR skew kurt sp.ent sfm mode centroid meanfun minfun maxfun meandom mindom maxdom dfrange modindx
0.8
0.4
0.0
−0.4
−0.8

In [ ]:

```
```

Analisando a correlação das variáveis, visualmente temos 5 grandes áreas que correlacionam.

Vamos segmentar a base e var as correlações entre homens e mulheres.

In [113]:

```
dfHomens = dataset[dataset["label"] == "male"]
dfMuheres = dataset[dataset["label"] == "female"]
```

In [114]:

```
###conferindo segmentação homens.
```

In [115]:

```
dfHomens.head(2)
```

Out[115]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt	sp.ent	sfm	...	centroid
0	0.184	0.064	0.191	0.142	0.226	0.075	2.196	8.442	0.893	0.492	...	0.184
1	0.184	0.067	0.191	0.142	0.226	0.073	2.196	8.442	0.892	0.514	...	0.184

2 rows × 21 columns

In [116]:

```
dfHomens.tail(2)
```

Out[116]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt	sp.ent	sfm	...	centroid
1582	0.162	0.06	0.140	0.113	0.224	0.112	3.507	8.442	0.907	0.413	...	0.162
1583	0.159	0.06	0.147	0.108	0.217	0.109	3.649	8.442	0.898	0.401	...	0.159

2 rows × 21 columns

In [117]:

```
###conferindo segmentação mulheres.
```

In [118]:

```
dfMuheres.head(2)
```

Out[118]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt	sp.ent	sfm	...	centroi
1584	0.158	0.083	0.191	0.062	0.225	0.162	2.801	8.442	0.952	0.679	...	0.15
1585	0.183	0.068	0.201	0.175	0.226	0.051	3.002	8.442	0.910	0.506	...	0.18

2 rows × 21 columns

In [119]:

```
dfMuheres.tail(2)
```

Out[119]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt	sp.ent	sfm	...	centroi
3166	0.144	0.091	0.185	0.044	0.220	0.176	1.591	5.388	0.950	0.675	...	0.14
3167	0.166	0.093	0.183	0.070	0.251	0.181	1.705	5.769	0.939	0.602	...	0.16

2 rows × 21 columns

In [120]:

```
## Correlação por seguimento.
```

In [121]:

```
# PANDAS: Correlação
Mcor = dfMuheres.corr(method='pearson')
print(Mcor)
```

```
           meanfreq     sd  median    Q25    Q75    IQR   skew   kurt  sp.e
nt    sfm   mode  \
meanfreq     1.000 -0.669   0.877  0.813  0.714 -0.554  0.031 -0.031  -0.6
34 -0.762  0.544
sd          -0.669  1.000  -0.405 -0.778 -0.177  0.843 -0.246 -0.130   0.8
15  0.918 -0.536
median       0.877 -0.405   1.000  0.683  0.824 -0.331 -0.049 -0.070  -0.5
02 -0.581  0.464
Q25          0.813 -0.778   0.683  1.000  0.513 -0.842  0.261  0.146  -0.7
59 -0.834  0.541
Q75          0.714 -0.177   0.824  0.513  1.000 -0.056 -0.233 -0.195  -0.2
32 -0.373  0.400
IQR         -0.554  0.843  -0.331 -0.842 -0.056  1.000 -0.422 -0.274   0.7
13  0.753 -0.433
skew         0.031 -0.246  -0.049  0.261 -0.233 -0.422  1.000  0.581  -0.3
83 -0.214 -0.036
kurt        -0.031 -0.130  -0.070  0.146 -0.195 -0.274  0.581  1.000  -0.2
40 -0.113 -0.081
sp.ent      -0.634  0.815  -0.502 -0.759 -0.232  0.713 -0.383 -0.240   1.0
00  0.895 -0.424
sfm         -0.762  0.918  -0.581 -0.834 -0.373  0.753 -0.214 -0.113   0.8
95  1.000 -0.505
mode         0.544 -0.536   0.464  0.541  0.400 -0.433 -0.036 -0.081  -0.4
24 -0.505  1.000
centroid     1.000 -0.669   0.877  0.813  0.714 -0.554  0.031 -0.031  -0.6
34 -0.762  0.544
meanfun      0.300 -0.078   0.425  0.150  0.318  0.006  0.078 -0.019  -0.2
70 -0.173  0.217
minfun       0.387 -0.364   0.308  0.273  0.276 -0.174 -0.048 -0.090  -0.3
25 -0.361  0.403
maxfun       0.401 -0.247   0.365  0.301  0.368 -0.140 -0.088 -0.092  -0.2
24 -0.282  0.274
meandom      0.482 -0.453   0.357  0.379  0.332 -0.271 -0.091 -0.113  -0.3
13 -0.424  0.450
mindom       0.386 -0.422   0.283  0.396  0.235 -0.342 -0.042 -0.057  -0.3
57 -0.397  0.368
maxdom       0.505 -0.507   0.376  0.417  0.317 -0.318 -0.043 -0.059  -0.3
98 -0.490  0.468
dfrange      0.503 -0.500   0.377  0.412  0.319 -0.311 -0.048 -0.061  -0.3
91 -0.484  0.465
modindx     -0.137  0.184  -0.085 -0.140 -0.073  0.128 -0.021 -0.025   0.1
50  0.170 -0.121

           centroid  meanfun  minfun  maxfun  meandom  mindom  maxdom  dfra
nge  modindx
meanfreq     1.000    0.300   0.387   0.401    0.482   0.386   0.505    0.
503   -0.137
sd          -0.669   -0.078  -0.364  -0.247   -0.453  -0.422  -0.507   -0.
500    0.184
median       0.877    0.425   0.308   0.365    0.357   0.283   0.376    0.
377   -0.085
Q25          0.813    0.150   0.273   0.301    0.379   0.396   0.417    0.
412   -0.140
Q75          0.714    0.318   0.276   0.368    0.332   0.235   0.317    0.
319   -0.073
IQR         -0.554    0.006  -0.174  -0.140   -0.271  -0.342  -0.318   -0.
311    0.128
skew         0.031    0.078  -0.048  -0.088   -0.091  -0.042  -0.043   -0.
048   -0.021
kurt        -0.031   -0.019  -0.090  -0.092   -0.113  -0.057  -0.059   -0.
061   -0.025
```

```
sp.ent      -0.634   -0.270  -0.325  -0.224   -0.313  -0.357  -0.398   -0.
391    0.150
sfm         -0.762   -0.173  -0.361  -0.282   -0.424  -0.397  -0.490   -0.
484    0.170
mode         0.544    0.217   0.403   0.274    0.450   0.368   0.468    0.
465   -0.121
centroid     1.000    0.300   0.387   0.401    0.482   0.386   0.505    0.
503   -0.137
meanfun      0.300    1.000   0.283   0.090   -0.009   0.009   0.038    0.
038    0.006
minfun       0.387    0.283   1.000   0.355    0.483   0.416   0.462    0.
461   -0.164
maxfun       0.401    0.090   0.355   1.000    0.429   0.341   0.414    0.
415   -0.162
meandom      0.482   -0.009   0.483   0.429    1.000   0.429   0.804    0.
804   -0.100
mindom       0.386    0.009   0.416   0.341    0.429   1.000   0.442    0.
440   -0.192
maxdom       0.505    0.038   0.462   0.414    0.804   0.442   1.000    0.
998   -0.270
dfrange      0.503    0.038   0.461   0.415    0.804   0.440   0.998    1.
000   -0.268
modindx     -0.137    0.006  -0.164  -0.162   -0.100  -0.192  -0.270   -0.
268    1.000
```

In [122]:

```
# PANDAS: Correlação
Hcor = dfHomens.corr(method='pearson')
print(Hcor)
```

```
           meanfreq     sd  median    Q25    Q75    IQR   skew   kurt  sp.e
nt    sfm   mode  \
meanfreq     1.000 -0.587   0.768  0.722  0.707 -0.321 -0.265 -0.249  -0.4
58 -0.698  0.593
sd          -0.587  1.000  -0.435 -0.692 -0.333  0.776  0.141  0.222   0.3
23  0.737 -0.566
median       0.768 -0.435   1.000  0.491  0.515 -0.197 -0.213 -0.188  -0.3
67 -0.534  0.525
Q25          0.722 -0.692   0.491  1.000  0.696 -0.637 -0.183 -0.224  -0.4
26 -0.696  0.593
Q75          0.707 -0.333   0.515  0.696  1.000 -0.070 -0.244 -0.236  -0.3
63 -0.555  0.555
IQR         -0.321  0.776  -0.197 -0.637 -0.070  1.000  0.046  0.125   0.1
34  0.439 -0.356
skew        -0.265  0.141  -0.213 -0.183 -0.244  0.046  1.000  0.756  -0.2
50 -0.007 -0.353
kurt        -0.249  0.222  -0.188 -0.224 -0.236  0.125  0.756  1.000  -0.1
73  0.079 -0.328
sp.ent      -0.458  0.323  -0.367 -0.426 -0.363  0.134 -0.250 -0.173   1.0
00  0.795 -0.176
sfm         -0.698  0.737  -0.534 -0.696 -0.555  0.439 -0.007  0.079   0.7
95  1.000 -0.438
mode         0.593 -0.566   0.525  0.593  0.555 -0.356 -0.353 -0.328  -0.1
76 -0.438  1.000
centroid     1.000 -0.587   0.768  0.722  0.707 -0.321 -0.265 -0.249  -0.4
58 -0.698  0.593
meanfun      0.477 -0.310   0.337  0.446  0.492 -0.193 -0.236 -0.230  -0.1
28 -0.323  0.441
minfun       0.451 -0.466   0.333  0.425  0.411 -0.236 -0.182 -0.242  -0.3
27 -0.468  0.488
maxfun       0.291 -0.207   0.238  0.252  0.298 -0.083 -0.194 -0.164  -0.1
48 -0.225  0.289
meandom      0.465 -0.432   0.372  0.450  0.446 -0.254 -0.306 -0.289  -0.0
91 -0.330  0.528
mindom       0.446 -0.448   0.360  0.424  0.402 -0.249 -0.317 -0.302  -0.1
77 -0.357  0.553
maxdom       0.459 -0.362   0.408  0.428  0.436 -0.211 -0.368 -0.313  -0.0
46 -0.280  0.520
dfrange      0.455 -0.357   0.406  0.424  0.432 -0.208 -0.374 -0.315  -0.0
41 -0.276  0.515
modindx     -0.209  0.069  -0.208 -0.134 -0.203 -0.028  0.080  0.069   0.1
46  0.177 -0.136

           centroid  meanfun  minfun  maxfun  meandom  mindom  maxdom  dfra
nge  modindx
meanfreq     1.000    0.477   0.451   0.291    0.465   0.446   0.459    0.
455   -0.209
sd          -0.587   -0.310  -0.466  -0.207   -0.432  -0.448  -0.362   -0.
357    0.069
median       0.768    0.337   0.333   0.238    0.372   0.360   0.408    0.
406   -0.208
Q25          0.722    0.446   0.425   0.252    0.450   0.424   0.428    0.
424   -0.134
Q75          0.707    0.492   0.411   0.298    0.446   0.402   0.436    0.
432   -0.203
IQR         -0.321   -0.193  -0.236  -0.083   -0.254  -0.249  -0.211   -0.
208   -0.028
skew        -0.265   -0.236  -0.182  -0.194   -0.306  -0.317  -0.368   -0.
374    0.080
kurt        -0.249   -0.230  -0.242  -0.164   -0.289  -0.302  -0.313   -0.
315    0.069
```

```
sp.ent      -0.458   -0.128  -0.327  -0.148   -0.091  -0.177  -0.046   -0.
041    0.146
sfm         -0.698   -0.323  -0.468  -0.225   -0.330  -0.357  -0.280   -0.
276    0.177
mode         0.593    0.441   0.488   0.289    0.528   0.553   0.520    0.
515   -0.136
centroid     1.000    0.477   0.451   0.291    0.465   0.446   0.459    0.
455   -0.209
meanfun      0.477    1.000   0.494   0.344    0.514   0.346   0.489    0.
490   -0.118
minfun       0.451    0.494   1.000   0.409    0.508   0.582   0.418    0.
418   -0.182
maxfun       0.291    0.344   0.409   1.000    0.324   0.336   0.308    0.
311   -0.183
meandom      0.465    0.514   0.508   0.324    1.000   0.472   0.805    0.
799   -0.014
mindom       0.446    0.346   0.582   0.336    0.472   1.000   0.420    0.
417   -0.148
maxdom       0.459    0.489   0.418   0.308    0.805   0.420   1.000    0.
996   -0.222
dfrange      0.455    0.490   0.418   0.311    0.799   0.417   0.996    1.
000   -0.225
modindx     -0.209   -0.118  -0.182  -0.183   -0.014  -0.148  -0.222   -0.
225    1.000
```

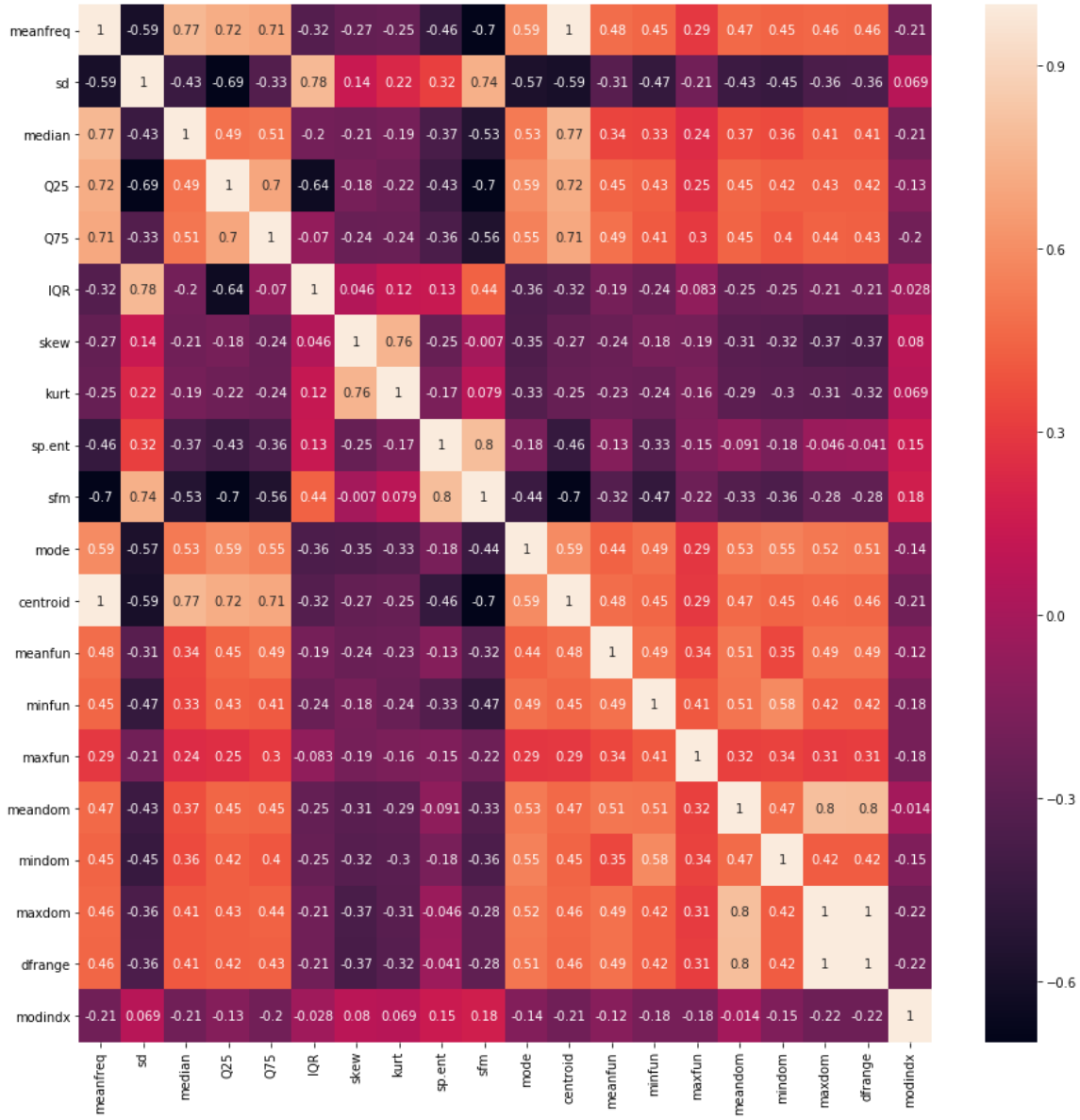
Homens

In [123]:

```
sb.heatmap(Hcor, annot = True)
```

Out[123]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1510a7f0>
```


meanfreq 1 -0.59 0.77 0.72 0.71 -0.32 -0.27 -0.25 -0.46 -0.7 0.59 1 0.48 0.45 0.29 0.47 0.45 0.46 0.46 -0.21
sd -0.59 1 -0.43 -0.69 -0.33 0.78 0.14 0.22 0.32 0.74 -0.57 -0.59 -0.31 -0.47 -0.21 -0.43 -0.45 -0.36 -0.36 0.069
median 0.77 -0.43 1 0.49 0.51 -0.2 -0.21 -0.19 -0.37 -0.53 0.53 0.77 0.34 0.33 0.24 0.37 0.36 0.41 0.41 -0.21
Q25 0.72 -0.69 0.49 1 0.7 -0.64 -0.18 -0.22 -0.43 -0.7 0.59 0.72 0.45 0.43 0.25 0.45 0.42 0.43 0.42 -0.13
Q75 0.71 -0.33 0.51 0.7 1 -0.07 -0.24 -0.24 -0.36 -0.56 0.55 0.71 0.49 0.41 0.3 0.45 0.4 0.44 0.43 -0.2
IQR -0.32 0.78 -0.2 -0.64 -0.07 1 0.046 0.12 0.13 0.44 -0.36 -0.32 -0.19 -0.24 -0.083 -0.25 -0.25 -0.21 -0.21 -0.028
skew -0.27 0.14 -0.21 -0.18 -0.24 0.046 1 0.76 -0.25 -0.007 -0.35 -0.27 -0.24 -0.18 -0.19 -0.31 -0.32 -0.37 -0.37 0.08
kurt -0.25 0.22 -0.19 -0.22 -0.24 0.12 0.76 1 -0.17 0.079 -0.33 -0.25 -0.23 -0.24 -0.16 -0.29 -0.3 -0.31 -0.32 0.069
sp.ent -0.46 0.32 -0.37 -0.43 -0.36 0.13 -0.25 -0.17 1 0.8 -0.18 -0.46 -0.13 -0.33 -0.15 -0.091 -0.18 -0.046 -0.041 0.15
sfm -0.7 0.74 -0.53 -0.7 -0.56 0.44 -0.007 0.079 0.8 1 -0.44 -0.7 -0.32 -0.47 -0.22 -0.33 -0.36 -0.28 -0.28 0.18
mode 0.59 -0.57 0.53 0.59 0.55 -0.36 -0.35 -0.33 -0.18 -0.44 1 0.59 0.44 0.49 0.29 0.53 0.55 0.52 0.51 -0.14
centroid 1 -0.59 0.77 0.72 0.71 -0.32 -0.27 -0.25 -0.46 -0.7 0.59 1 0.48 0.45 0.29 0.47 0.45 0.46 0.46 -0.21
meanfun 0.48 -0.31 0.34 0.45 0.49 -0.19 -0.24 -0.23 -0.13 -0.32 0.44 0.48 1 0.49 0.34 0.51 0.35 0.49 0.49 -0.12
minfun 0.45 -0.47 0.33 0.43 0.41 -0.24 -0.18 -0.24 -0.33 -0.47 0.49 0.45 0.49 1 0.41 0.51 0.58 0.42 0.42 -0.18
maxfun 0.29 -0.21 0.24 0.25 0.3 -0.083 -0.19 -0.16 -0.15 -0.22 0.29 0.29 0.34 0.41 1 0.32 0.34 0.31 0.31 -0.18
meandom 0.47 -0.43 0.37 0.45 0.45 -0.25 -0.31 -0.29 -0.091 -0.33 0.53 0.47 0.51 0.51 0.32 1 0.47 0.8 0.8 -0.014
mindom 0.45 -0.45 0.36 0.42 0.4 -0.25 -0.32 -0.3 -0.18 -0.36 0.55 0.45 0.35 0.58 0.34 0.47 1 0.42 0.42 -0.15
maxdom 0.46 -0.36 0.41 0.43 0.44 -0.21 -0.37 -0.31 -0.046 -0.28 0.52 0.46 0.49 0.42 0.31 0.8 0.42 1 1 -0.22
dfrange 0.46 -0.36 0.41 0.42 0.43 -0.21 -0.37 -0.32 -0.041 -0.28 0.51 0.46 0.49 0.42 0.31 0.8 0.42 1 1 -0.22
modindx -0.21 0.069 -0.21 -0.13 -0.2 -0.028 0.08 0.069 0.15 0.18 -0.14 -0.21 -0.12 -0.18 -0.18 -0.014 -0.15 -0.22 -0.22 1
meanfreq sd median Q25 Q75 IQR skew kurt sp.ent sfm mode centroid meanfun minfun maxfun meandom mindom maxdom dfrange modindx
0.9 0.6 0.3 0.0 −0.3 −0.6

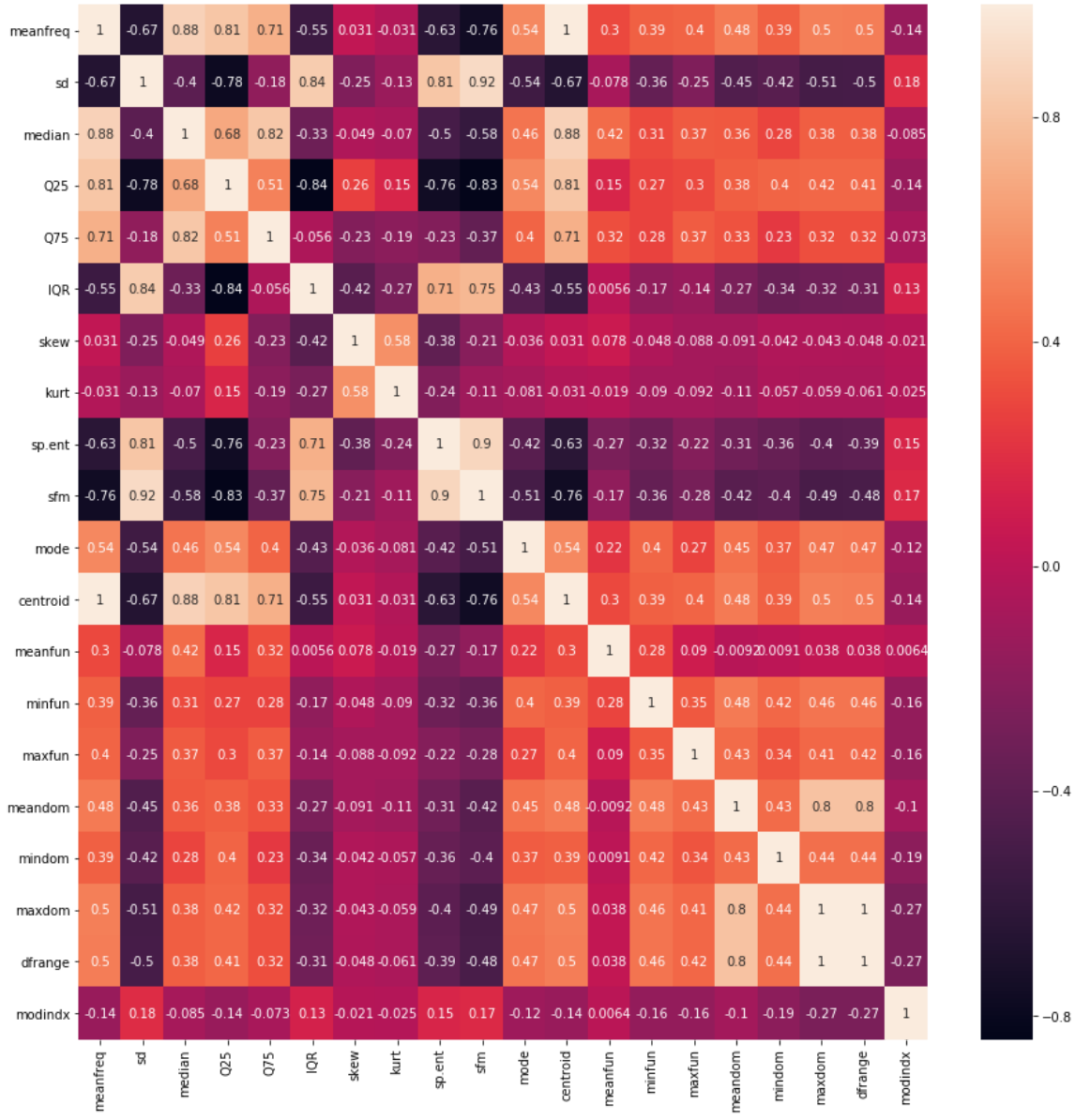
Mulheres

In [124]:

```
sb.heatmap(Mcor, annot = True)
```

Out[124]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x16151730>
```



Não houve grandes diferenças por seguimento na correlação.

Finalização, Apos análises deparamos com valores discrepantes, no qual foram substituídos pela média, Os dados representam arquivos de áudio amostrado, o que pode ter sido gravo com auto indexe de ruído e outras interferências, a base limpa está salva, vamos para etapa de treinamento do modelo.

In [125]:

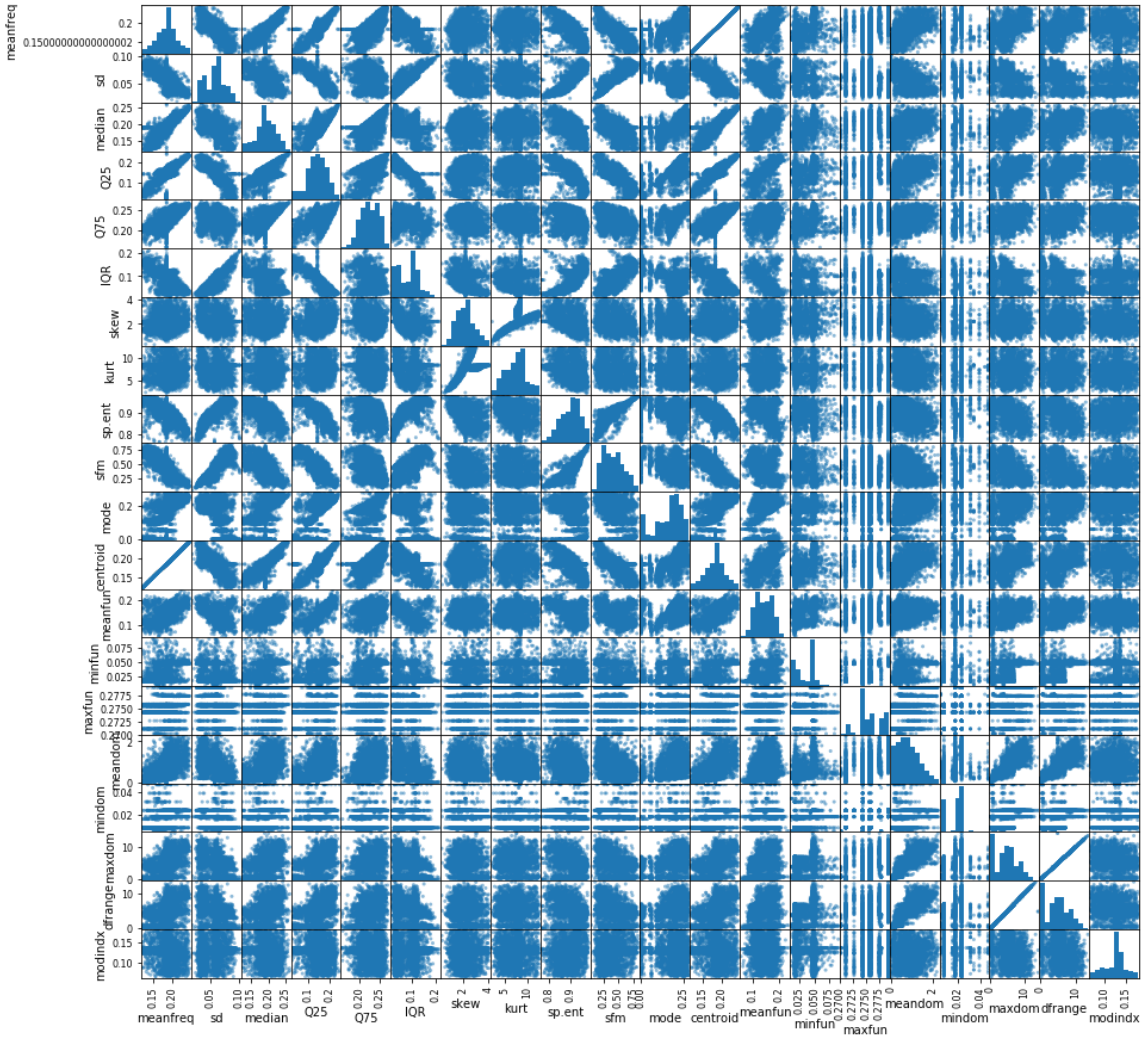
```
dataset.to_csv(".\\baseDados\\voice_fix.csv")
```

Gráfico de dispersão geral e por seguimento.

Geral dataset total.

In [126]:

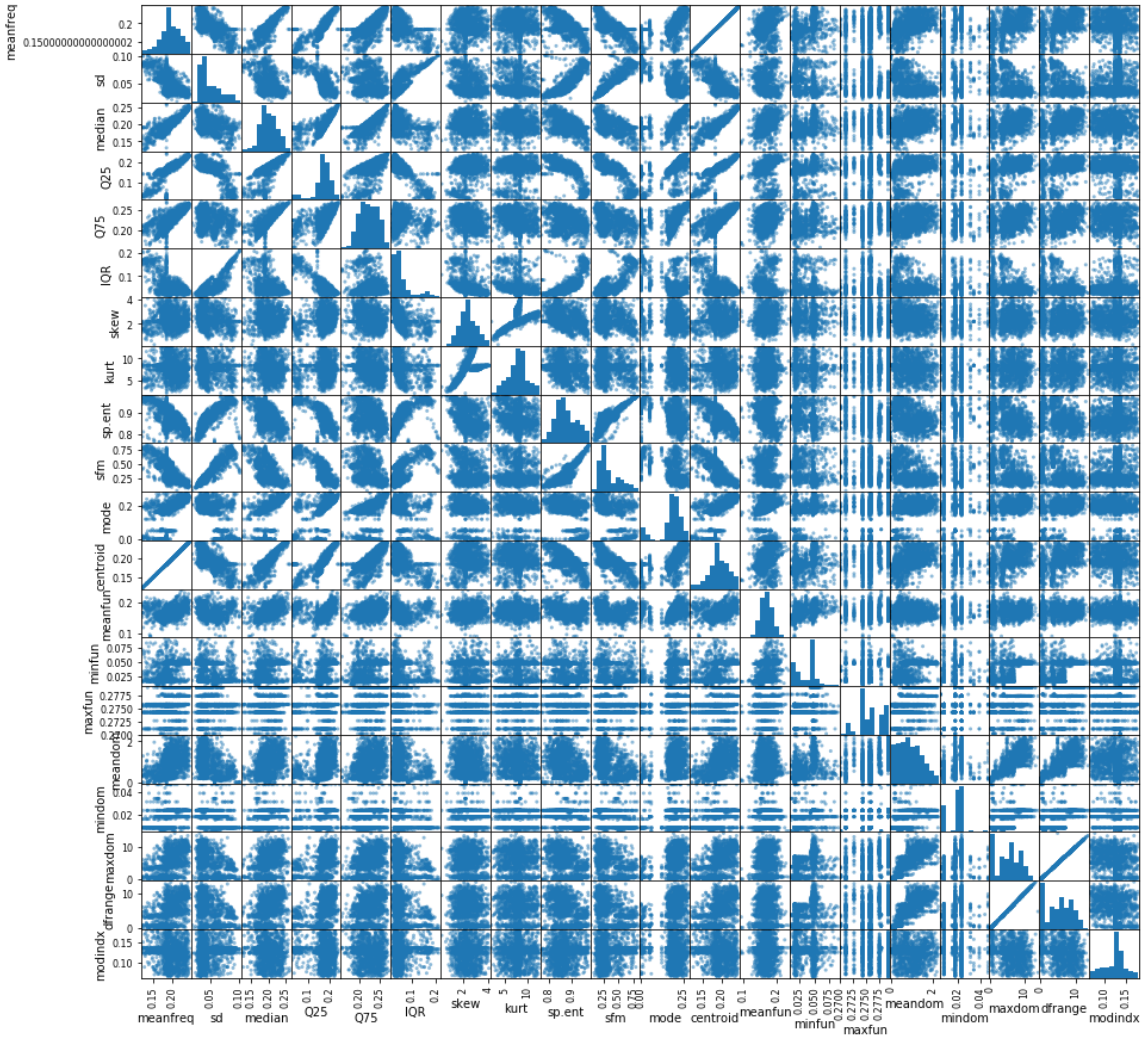
```
# Gráfico de dispersão (multivariado)
scatter_matrix(dataset)
plt.rcParams['figure.figsize'] = (15,15)
plt.show()
```



Dataset Mulheres

In [127]:

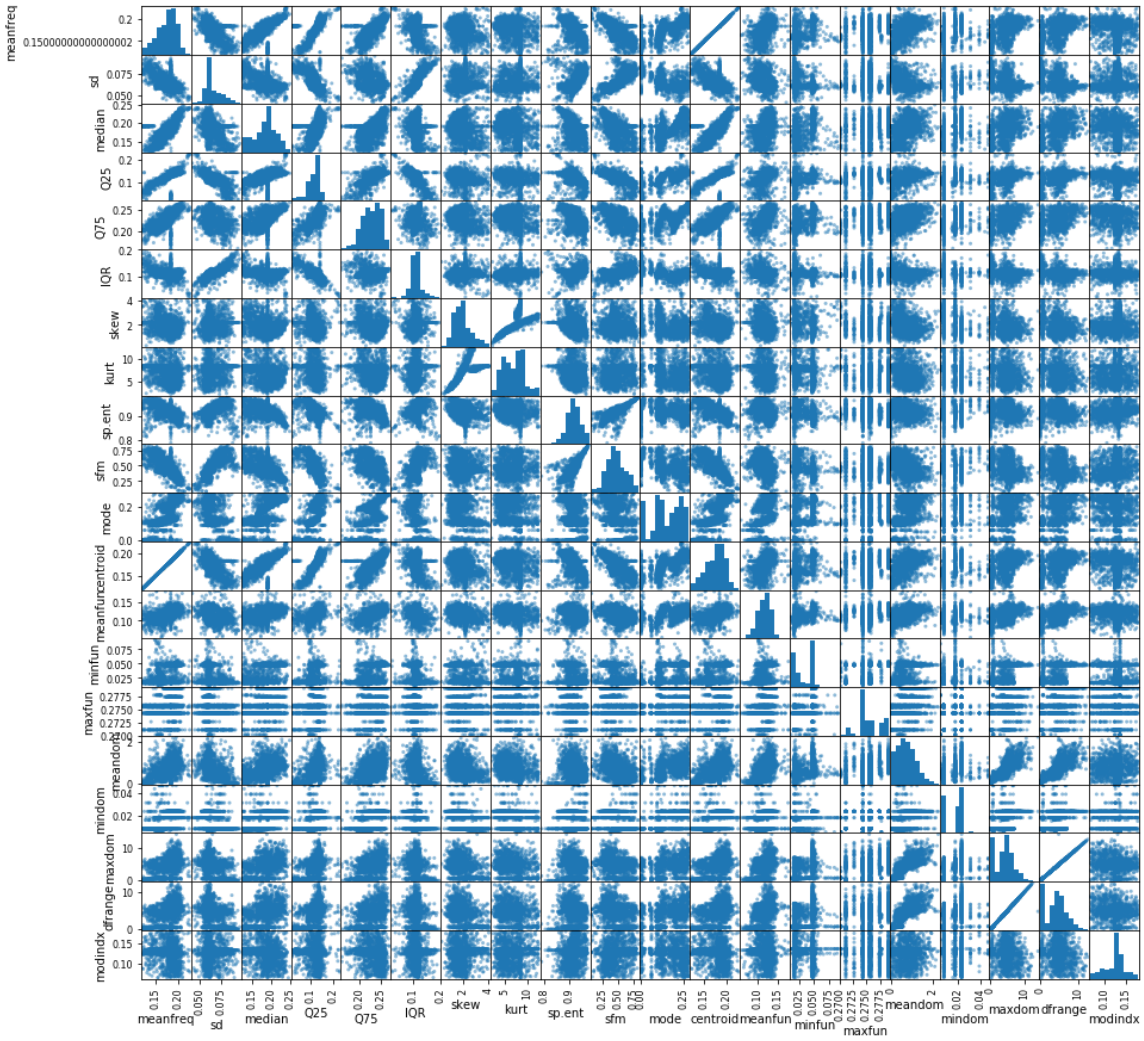
```
# Gráfico de dispersão (multivariado)
scatter_matrix(dfMuheres)
plt.rcParams['figure.figsize'] = (15,15)
plt.show()
```



Dataset Homens

In [128]:

```
# Gráfico de dispersão (multivariado)
scatter_matrix(dfHomens)
plt.rcParams['figure.figsize'] = (15,15)
plt.show()
```



No gráfico de dispersão podemos encontrar correlações positivas frequentes entre as variáveis, isso é visto de forma clara no gráfico de vozes masculinas.

In [ ]:

```

```

Comparativo dos dados.

In [2]:

```
%matplotlib inline
```

In [23]:

```
# Importa as bibliotecas
import pandas as pd
import matplotlib.pyplot as plt
import numpy as np
#from pandas.tools.plotting import scatter_matrix
from  pandas.plotting  import scatter_matrix
import seaborn as sb
```

In [8]:

```
# Carrega os dados

url = ".\\baseDados\\voice_fix.csv"
#colunas = ["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meandom","mindom","maxdom","dfrange","modindx","label"]
dataset = pandas.read_csv(url,  sep = ",")
```

In [9]:

```
dataset.head()
```

Out[9]:

	Unnamed: 0	meanfreq	sd	median	Q25	Q75	IQR	skew	ku
0	0	0.183506	0.064241	0.190591	0.142287	0.225624	0.075122	2.196061	8.44236
1	1	0.183506	0.067310	0.190591	0.142482	0.225624	0.073252	2.196061	8.44236
2	2	0.183506	0.083829	0.190591	0.142287	0.225624	0.123207	2.196061	8.44236
3	3	0.151228	0.072111	0.158011	0.096582	0.207955	0.111374	1.232831	4.17729
4	4	0.135120	0.079146	0.124656	0.078720	0.206045	0.127325	1.101174	4.3337

5 rows × 22 columns

In [11]:

```
dfHomens = dataset[dataset["label"] == "male"]
dfMuheres = dataset[dataset["label"] == "female"]
```

In [12]:

```
dfHomens.head()
```

Out[12]:

	Unnamed: 0	meanfreq	sd	median	Q25	Q75	IQR	skew	ku
0	0	0.183506	0.064241	0.190591	0.142287	0.225624	0.075122	2.196061	8.44236
1	1	0.183506	0.067310	0.190591	0.142482	0.225624	0.073252	2.196061	8.44236
2	2	0.183506	0.083829	0.190591	0.142287	0.225624	0.123207	2.196061	8.44236
3	3	0.151228	0.072111	0.158011	0.096582	0.207955	0.111374	1.232831	4.17729
4	4	0.135120	0.079146	0.124656	0.078720	0.206045	0.127325	1.101174	4.33371

5 rows × 22 columns

In [159]:

```
dfMuheres.head()
```

Out[159]:

	Unnamed: 0	meanfreq	sd	median	Q25	Q75	IQR	skew	
1584	1584	0.158108	0.082782	0.191191	0.062350	0.224552	0.162202	2.801344	8.4
1585	1585	0.182855	0.067789	0.200639	0.175489	0.226068	0.050579	3.001890	8.4
1586	1586	0.199807	0.061974	0.211358	0.184422	0.235687	0.051265	2.543841	7.5
1587	1587	0.195280	0.072087	0.204656	0.180611	0.255954	0.075344	2.392326	10.0
1588	1588	0.208504	0.057550	0.220229	0.190343	0.249759	0.059416	1.707786	5.6

5 rows × 22 columns

Gráfico comparativo com valores máximos.

In [207]:

```
DadosMax = []
for x in colunas:
    if x == "label":
        continue
    Linha =[]
    Linha.append(dataset[x].max())
    Linha.append(dfMuheres[x].max())
    Linha.append(dfHomens[x].max())
    DadosMax.append(Linha)
```

In [208]:

```
df = pd.DataFrame(DadosMax,
                  index=["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meandom","mindom","maxdom","dfrange","modindx"],
                  columns=pd.Index(['Geral', 'Mulheres', 'Homens'],
                 name='Valores Maximos')).round(2)


df.plot(kind='bar',figsize=(15,8))
```

Out[208]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x172e01d0>
```

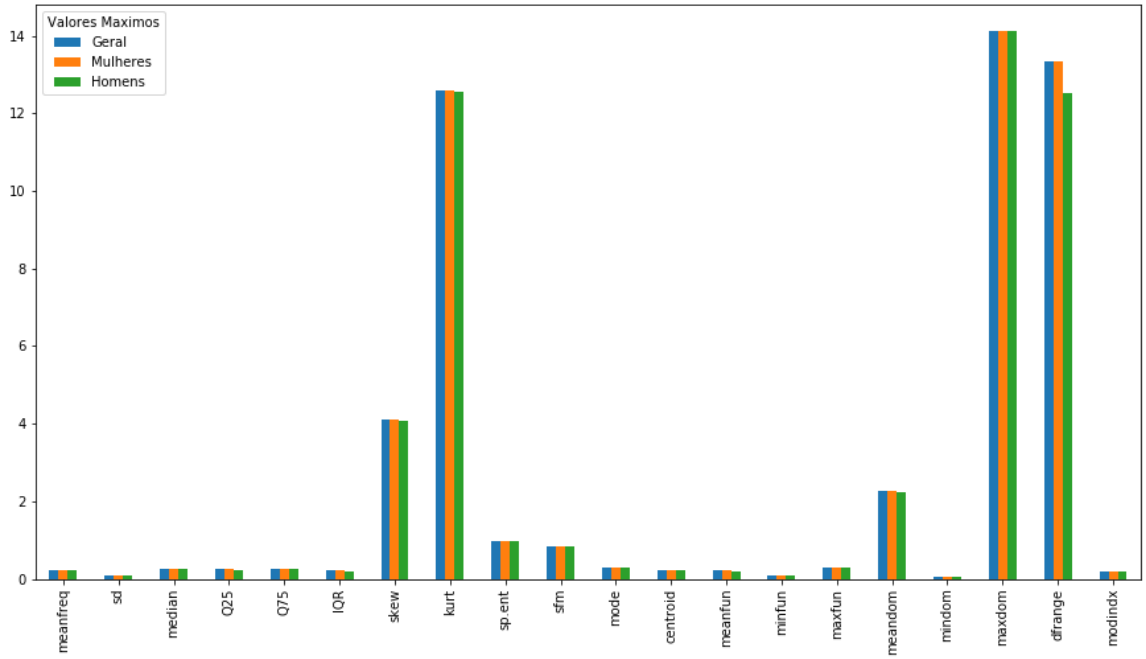


Gráfico comparativo com valores mínimos.

In [209]:

```
DadosMin = []
for x in colunas:
    if x == "label":
        continue
    Linha =[]
    Linha.append(dataset[x].min())
    Linha.append(dfMuheres[x].min())
    Linha.append(dfHomens[x].min())
    DadosMin.append(Linha)
```

In [210]:

```
df = pd.DataFrame(DadosMin,
                  index=["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meandom","mindom","maxdom","dfrange","modindx"],
                  columns=pd.Index(['Geral', 'Mulheres', 'Homens'],
                 name='Valores Mínimos')).round(2)


df.plot(kind='bar',figsize=(15,8))
```

Out[210]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x181da450>
```

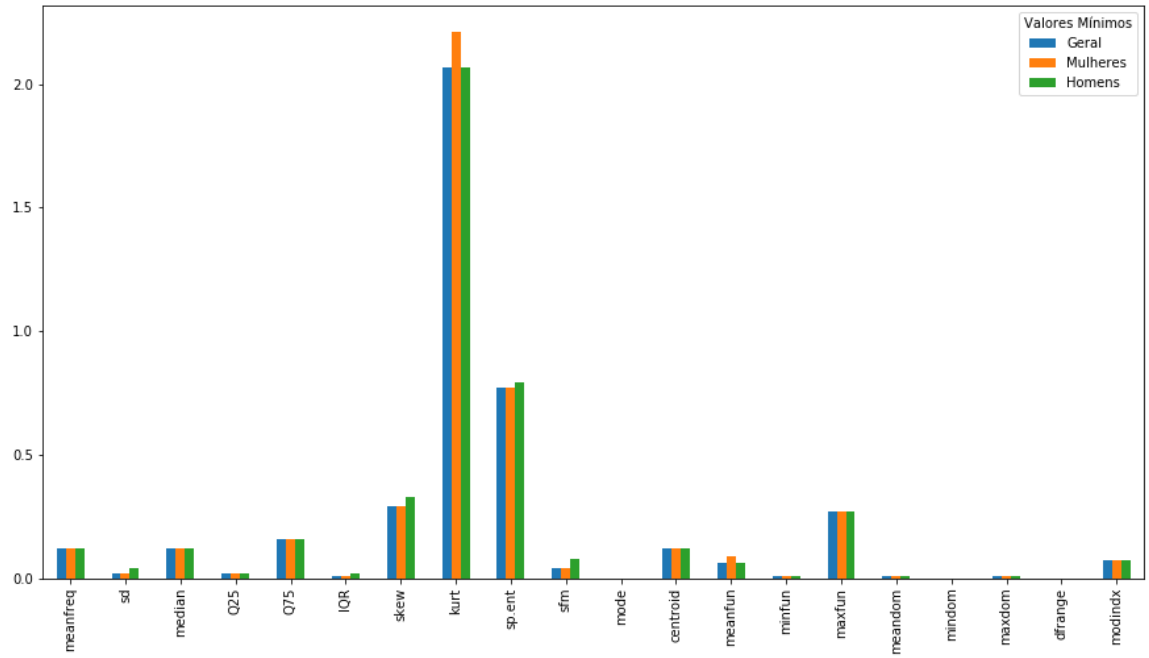


Gráfico comparativo com valores média.

In [211]:

```
DadosMedia = []
for x in colunas:
    if x == "label":
        continue
    Linha =[]
    Linha.append(dataset[x].mean())
    Linha.append(dfMuheres[x].mean())
    Linha.append(dfHomens[x].mean())
    DadosMedia.append(Linha)
```

In [212]:

```
df = pd.DataFrame(DadosMedia,
                  index=["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meandom","mindom","maxdom","dfrange","modindx"],
                  columns=pd.Index(['Geral', 'Mulheres', 'Homens'],
                 name='Média')).round(2)


df.plot(kind='bar',figsize=(15,8))
```

Out[212]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x10761050>
```

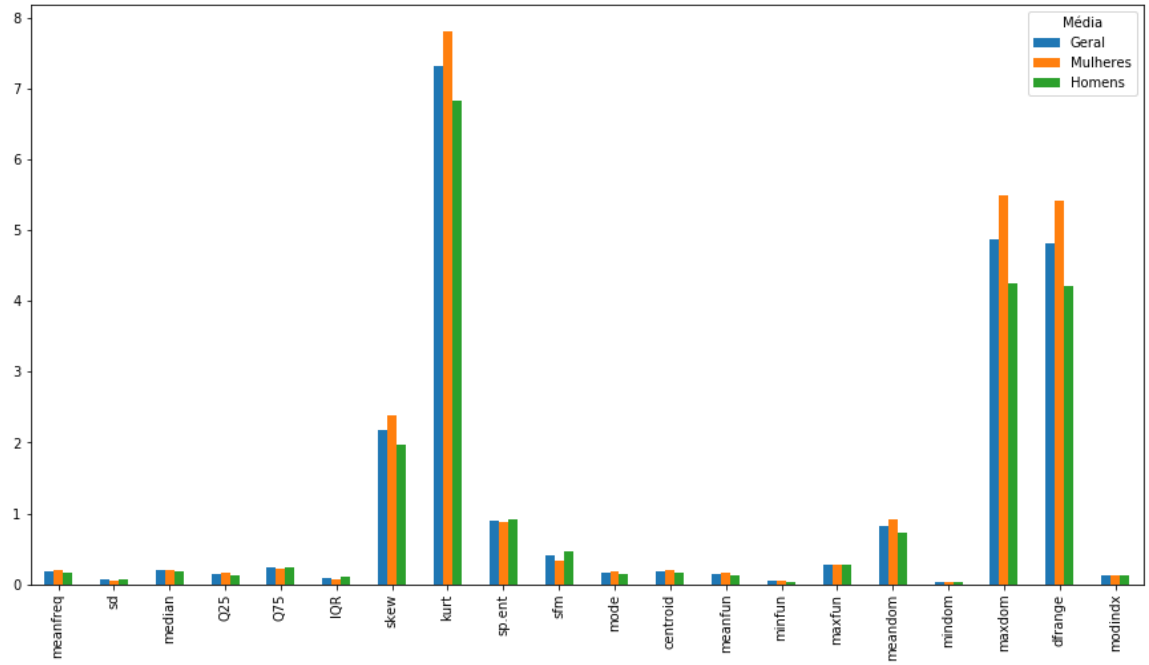


Gráfico comparativo com valores mediana.

In [ ]:

```
```

In [213]:

```
DadosMediana = []
for x in colunas:
    if x == "label":
        continue
    Linha =[]
    Linha.append(dataset[x].quantile(q=0.50))
    Linha.append(dfMuheres[x].quantile(q=0.50))
    Linha.append(dfHomens[x].quantile(q=0.50))
    DadosMediana.append(Linha)
```

In [214]:

```
df = pd.DataFrame(DadosMediana,
                  index=["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meandom","mindom","maxdom","dfrange","modindx"],
                  columns=pd.Index(['Geral', 'Mulheres', 'Homens'],
                 name='Mediana')).round(2)


df.plot(kind='bar',figsize=(15,8))
```

Out[214]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x19504f50>
```

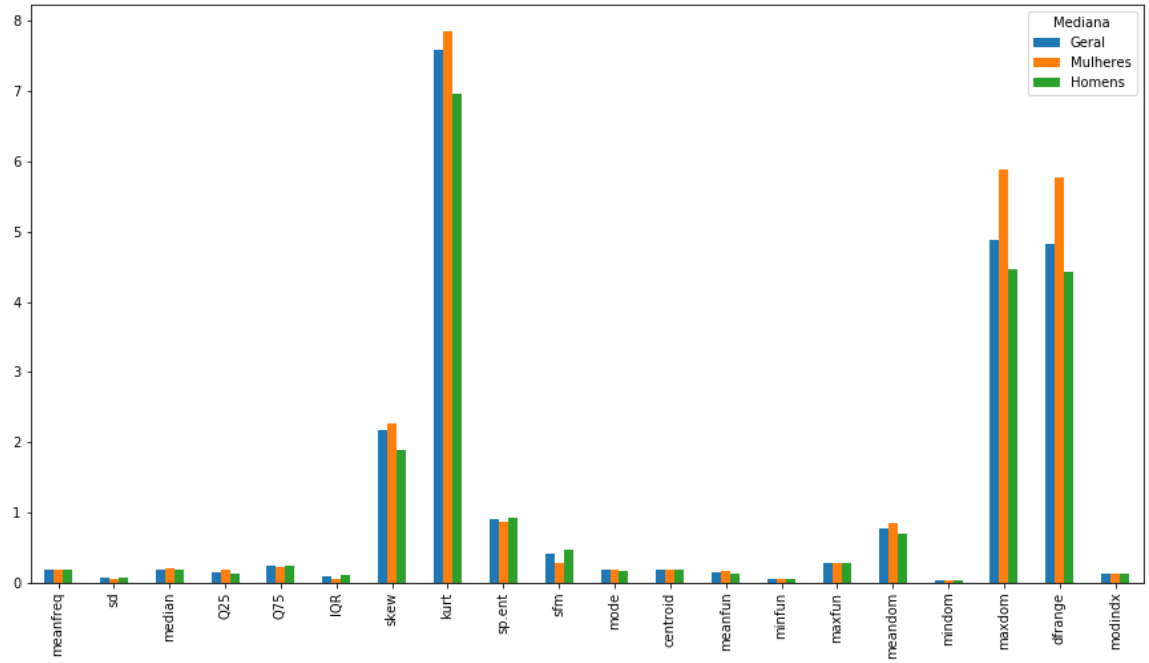


Gráfico comparativo com valores Desvio padrão.

In [215]:

```
Dadosdp = []
for x in colunas:
    if x == "label":
        continue
    Linha =[]
    Linha.append(dataset[x].std())
    Linha.append(dfMuheres[x].std())
    Linha.append(dfHomens[x].std())
    Dadosdp.append(Linha)
```

In [216]:

```
df = pd.DataFrame(Dadosdp,
                  index=["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meandom","mindom","maxdom","dfrange","modindx"],
                  columns=pd.Index(['Geral', 'Mulheres', 'Homens'],
                 name='Desvio padrão')).round(2)


df.plot(kind='bar',figsize=(15,8))
```

Out[216]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x195af350>
```

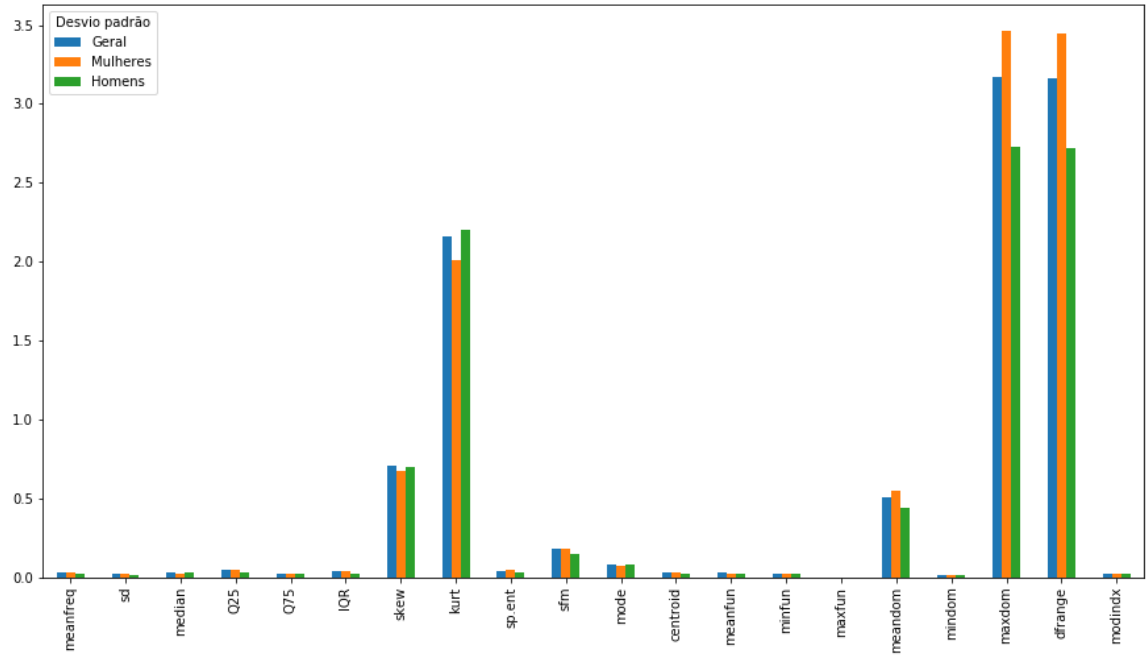


Gráfico comparativo com valores Variância.

In [217]:

```
Dadosvr = []
for x in colunas:
    if x == "label":
        continue
    Linha =[]
    Linha.append(dataset[x].var())
    Linha.append(dfMuheres[x].var())
    Linha.append(dfHomens[x].var())
    Dadosvr.append(Linha)
```

In [204]:

```
df = pd.DataFrame(Dadosvr,
                  index=["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.e
nt","sfm","mode","centroid","meanfun","minfun","maxfun","meandom","mindom","maxdom","df
range","modindx"],
                  columns=pd.Index(['Geral', 'Mulheres', 'Homens'],
                 name='Variância')).round(2)


df.plot(kind='bar',figsize=(15,8))
```

Out[204]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x16fc92b0>
```

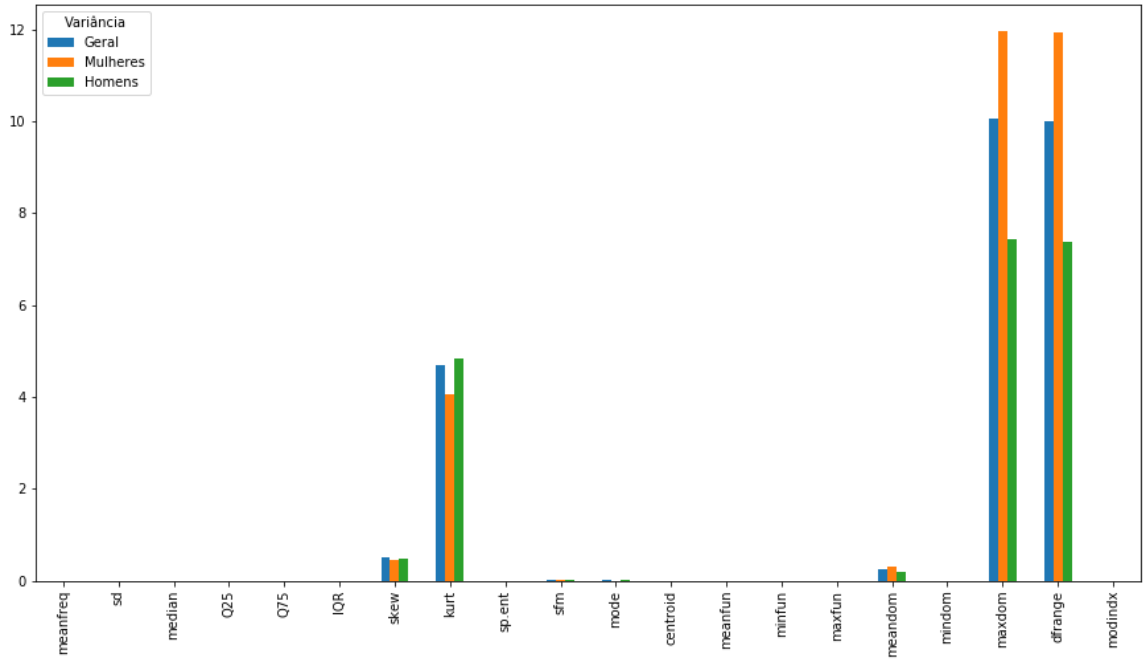


Gráfico comparativo com valores Amplitude.

In [225]:

```
Dados = []
for x in colunas:
    if x == "label":
        continue
    Linha =[]

    G=dataset[x].max() - dataset[x].min()
    M=dfMuheres[x].max() - dfMuheres[x].min()
    H=dfHomens[x].max() - dfHomens[x].min()


    Linha.append(G)
    Linha.append(M)
    Linha.append(H)
    Dados.append(Linha)
```

In [226]:

```
df = pd.DataFrame(Dados,
                  index=["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meandom","mindom","maxdom","dfrange","modindx"],
                  columns=pd.Index(['Geral', 'Mulheres', 'Homens'],
                 name='Amplitude')).round(2)


df.plot(kind='bar',figsize=(15,8))
```

Out[226]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x19676910>
```

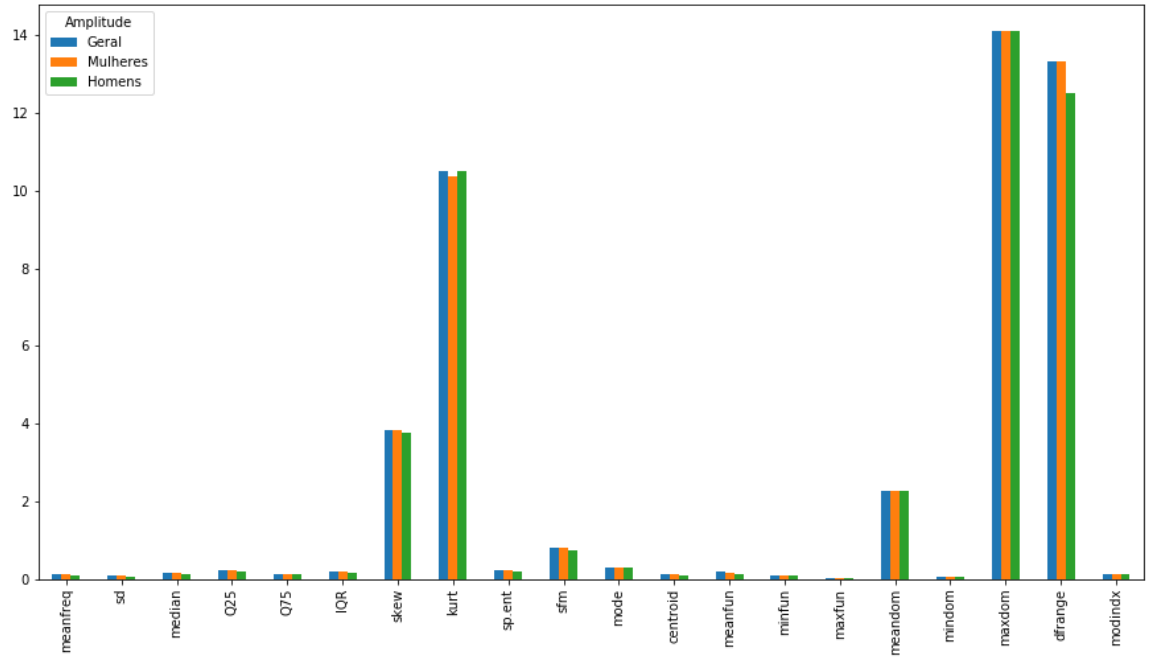


Gráfico comparativo com valores Moda.

In [231]:

```
Dados = []
for x in colunas:
    if x == "label":
        continue
    Linha =[]
    Linha.append(dataset[x].mode()[0])
    Linha.append(dfMuheres[x].mode()[0])
    Linha.append(dfHomens[x].mode()[0])
    Dados.append(Linha)
```

In [232]:

```
df = pd.DataFrame(Dados,
                  index=["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meandom","mindom","maxdom","dfrange","modindx"],
                  columns=pd.Index(['Geral', 'Mulheres', 'Homens'],
                 name='MODA')).round(2)


df.plot(kind='bar',figsize=(15,8))
```

Out[232]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1a0a1290>
```

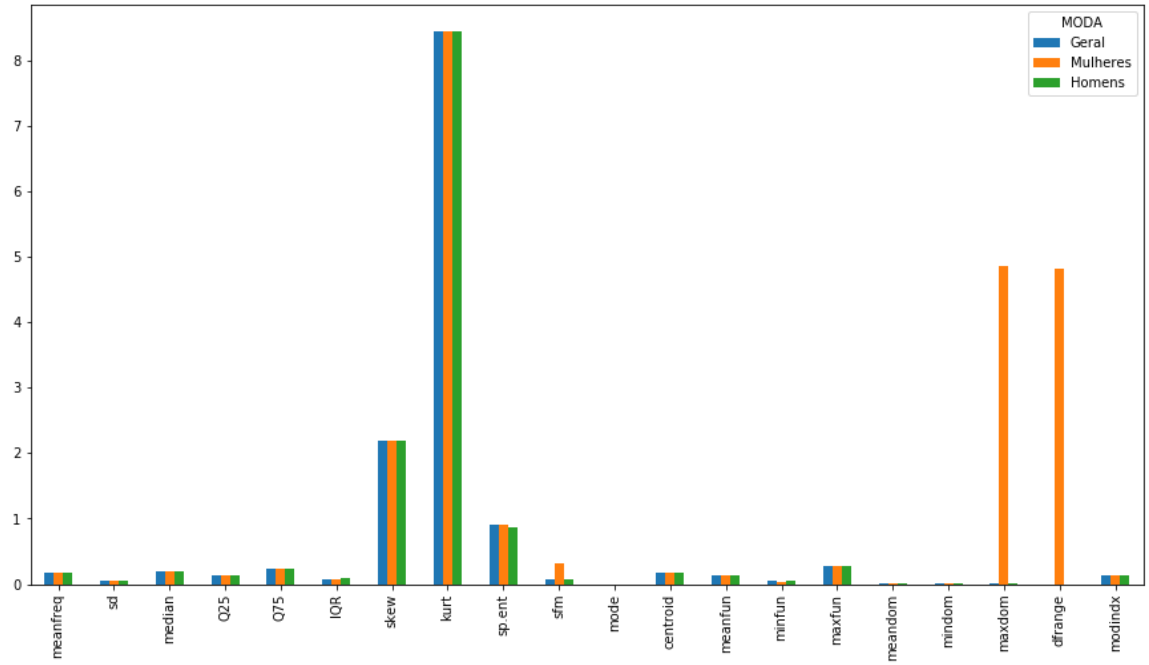


Gráfico comparativo com valores Coeficiente de variação.

In [235]:

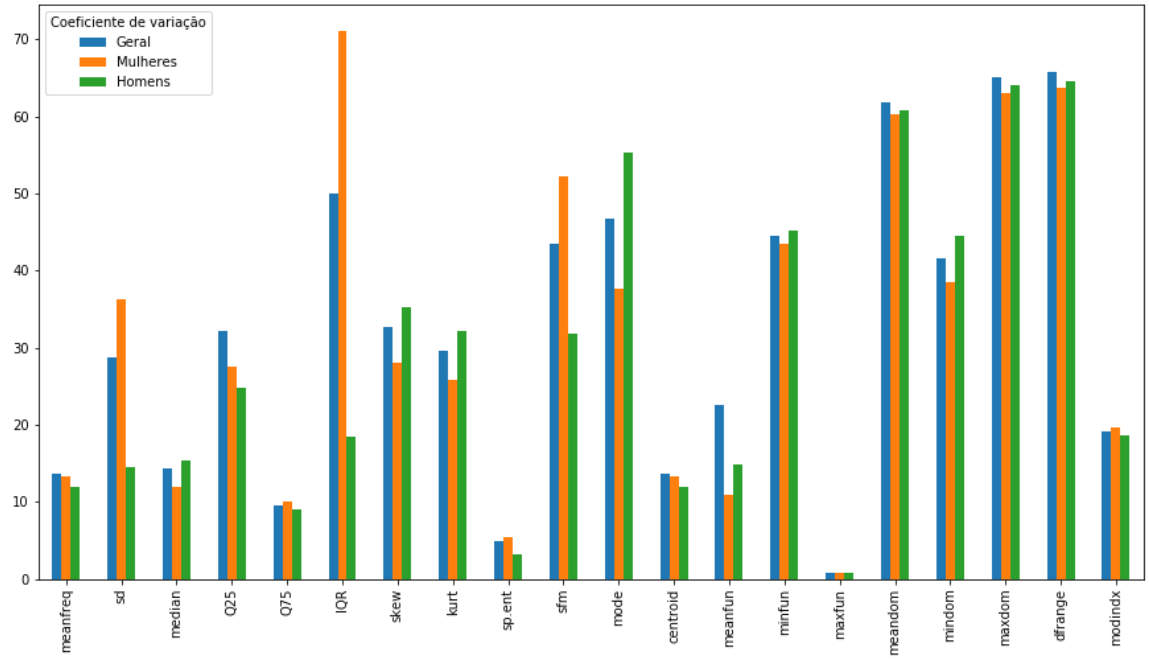
```
Dados = []
for x in colunas:
    if x == "label":
        continue
    Linha =[]
    Linha.append((dataset[x].std()/dataset[x].mean()) *  100)
    Linha.append((dfMuheres[x].std()/dfMuheres[x].mean()) *  100)
    Linha.append((dfHomens[x].std()/dfHomens[x].mean()) *  100)
    Dados.append(Linha)
```

In [236]:

```
df = pd.DataFrame(Dados,
                  index=["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meandom","mindom","maxdom","dfrange","modindx"],
                  columns=pd.Index(['Geral', 'Mulheres', 'Homens'],
                 name='Coeficiente de variação')).round(2)


df.plot(kind='bar',figsize=(15,8))
```

Out[236]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1a1a4610>
```



Fim da análise exploraria.