Introdução.

Este 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, possibilitando a implantação em dispositivos embarcados de baixo custo.

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 quartil (em kHz) sobre as amostras compostas no sinal de arquivo de voz;
- **Q75** : terceiro quartil (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 predominante;
- **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** : rótulo de identificador da amostra em relação ao sexo, adicionado durante a gravação "male" ou "female".

Análise 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","mode","ce
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	sp.ent	sfm	...	c
0	0.059781	0.064241	0.032027	0.015071	0.090193	0.075122	12.863462	274.402906	0.893369	0.491918	...	0
1	0.066009	0.067310	0.040229	0.019414	0.092666	0.073252	22.423285	634.613855	0.892193	0.513724	...	0
2	0.077316	0.083829	0.036718	0.008701	0.131908	0.123207	30.757155	1024.927705	0.846389	0.478905	...	0
3	0.151228	0.072111	0.158011	0.096582	0.207955	0.111374	1.232831	4.177296	0.963322	0.727232	...	0
4	0.135120	0.079146	0.124656	0.078720	0.206045	0.127325	1.101174	4.333713	0.971955	0.783568	...	0

5 rows × 21 columns

In [6]:

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

```
      meanfreq        sd    median       Q25       Q75       IQR      skew  \
3166  0.143659  0.090628  0.184976  0.043508  0.219943  0.176435  1.591065
3167  0.165509  0.092884  0.183044  0.070072  0.250827  0.180756  1.705029

          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]
```

Verificando valores nulos.

In [7]:

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

In [8]:
```
dfnull.isnull().sum()
```

Out[8]:
```
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 [9]:
```
#!pip install missingno
#!pip3 install missingno


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

Out[9]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x13102570>
```

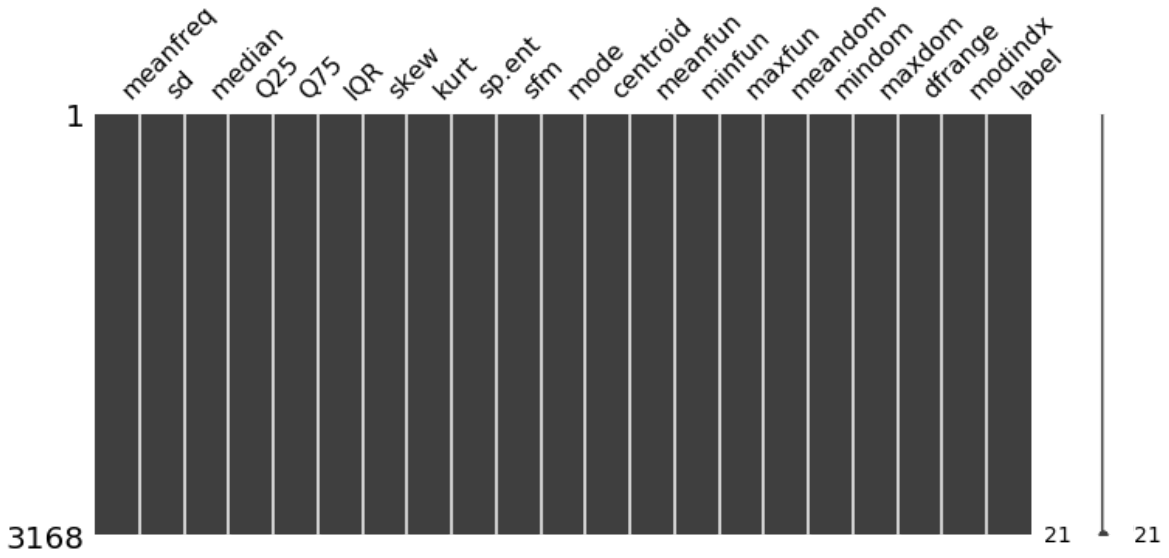


Tabela sem elementos nulos tem a mesma dimensão da tabela original, portanto a base não possui valores nulos.

Verifica os tipos de dados de cada atributo.

In [10]:
```
tipos = dataset.dtypes
print(tipos)
```

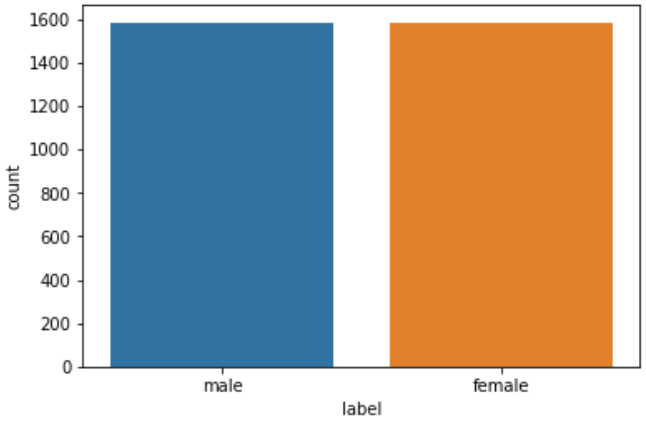
```
meanfreq    float64
sd          float64
median      float64
Q25         float64
Q75         float64
IQR         float64
skew        float64
kurt        float64
sp.ent      float64
sfm         float64
mode        float64
centroid    float64
meanfun     float64
minfun      float64
maxfun      float64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

Variáveis Categóricas

In [11]:
```
contagem = dataset.groupby('label').size()
print(contagem)
```

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

In [12]:
```
sb.countplot('label',data=dataset)
plt.rcParams['figure.figsize'] = (10,5)
plt.show()
```



In [13]:
```
## Separação dos dados pela classe label, vozes de homens e mulheres.
dfHomens = dataset[dataset["label"] == "male"]
dfMulheres = dataset[dataset["label"] == "female"]
```

Conferindo segmentações vozes masculinas.

In [14]:
```
dfHomens.head(2)
```

Out[14]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt	sp.ent	sfm	...	ce
0	0.059781	0.064241	0.032027	0.015071	0.090193	0.075122	12.863462	274.402906	0.893369	0.491918	...	0.(
1	0.066009	0.067310	0.040229	0.019414	0.092666	0.073252	22.423285	634.613855	0.892193	0.513724	...	0.(

2 rows × 21 columns

In [15]:
```
dfHomens.tail(2)
```

Out[15]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt	sp.ent	sfm	...	(
1582	0.162350	0.060335	0.140085	0.112611	0.224204	0.111593	3.506742	20.298964	0.907180	0.412580	...	0
1583	0.158781	0.059852	0.147013	0.107879	0.216797	0.108918	3.648593	20.799925	0.898225	0.401169	...	0

2 rows × 21 columns

Conferindo segmentações vozes femininas.

In [16]:
```
dfMulheres.head(2)
```

Out[16]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt	sp.ent	sfm	...	(
1584	0.158108	0.082782	0.191191	0.062350	0.224552	0.162202	2.801344	19.929617	0.952161	0.679223	...	0
1585	0.182855	0.067789	0.200639	0.175489	0.226068	0.050579	3.001890	19.865482	0.910458	0.506099	...	0

2 rows × 21 columns

In [17]:
```
dfMulheres.tail(2)
```

Out[17]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt	sp.ent	sfm	...	ce
3166	0.143659	0.090628	0.184976	0.043508	0.219943	0.176435	1.591065	5.388298	0.950436	0.675470	...	0.
3167	0.165509	0.092884	0.183044	0.070072	0.250827	0.180756	1.705029	5.769115	0.938829	0.601529	...	0.

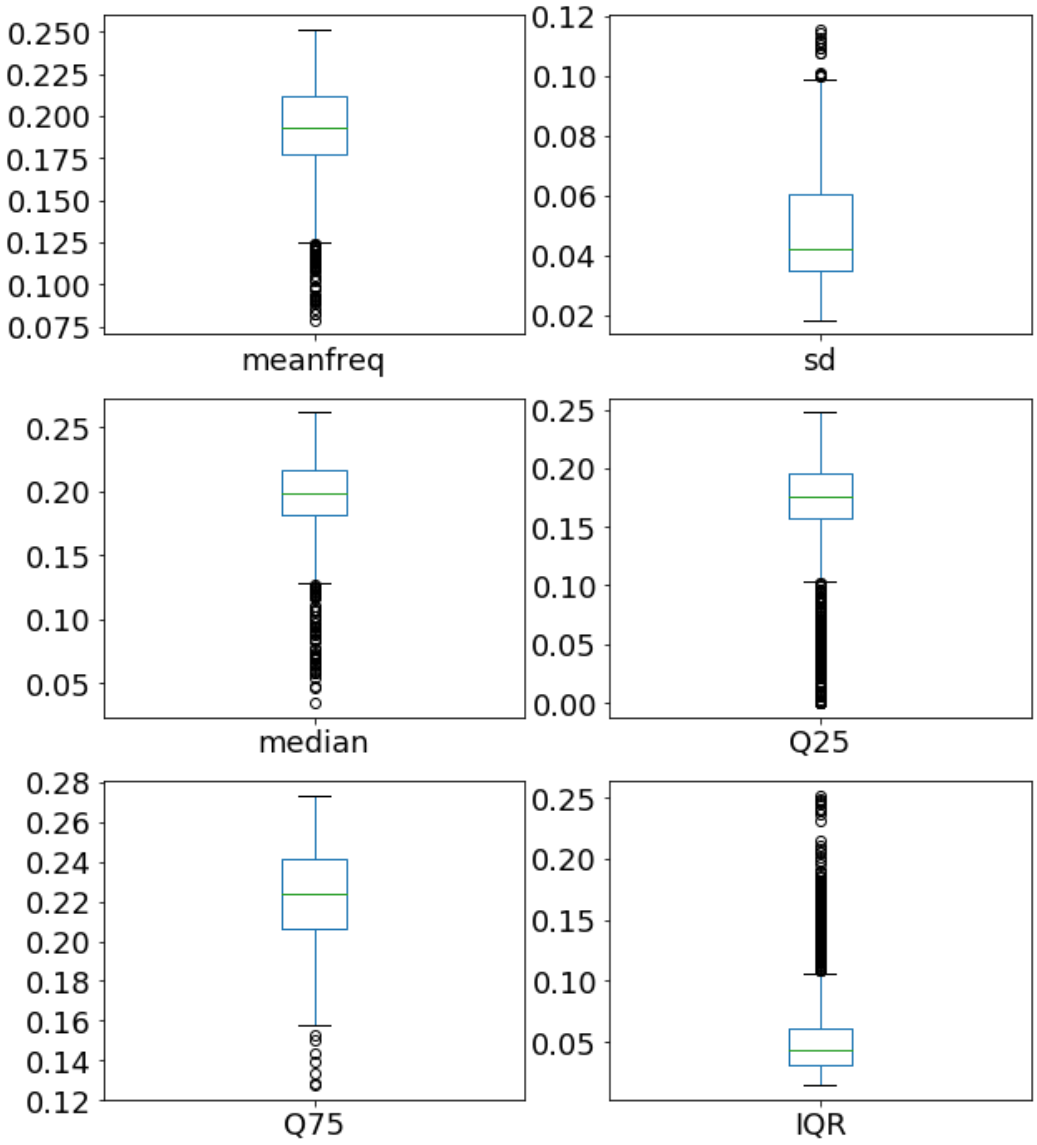
2 rows × 21 columns

BOXPLOT vozes femininas - Verificando discrepâncias

In [18]:

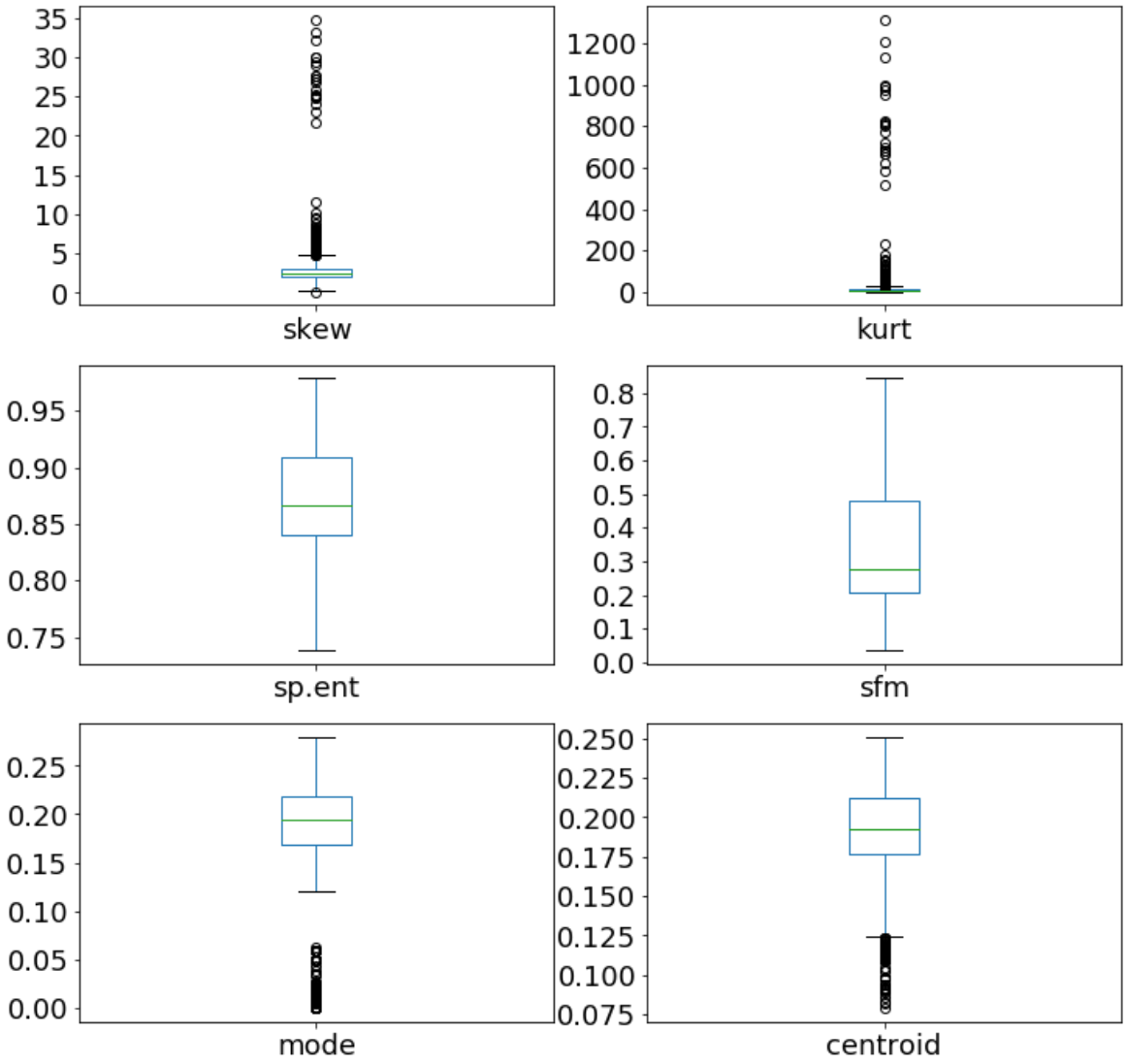
```
print(colunas)
plt.rcParams['figure.figsize'] = (10,12)
dfMulheres[colunas[0:6]].plot(kind='box', subplots=True, layout=(3,2), sharex=False, sharey=F
plt.show()
```

```
['meanfreq', 'sd', 'median', 'Q25', 'Q75', 'IQR', 'skew', 'kurt', 'sp.ent', 'sfm', 'mode',
'centroid', 'meanfun', 'minfun', 'maxfun', 'meandom', 'mindom', 'maxdom', 'dfrange', 'modind
x', 'label']
```



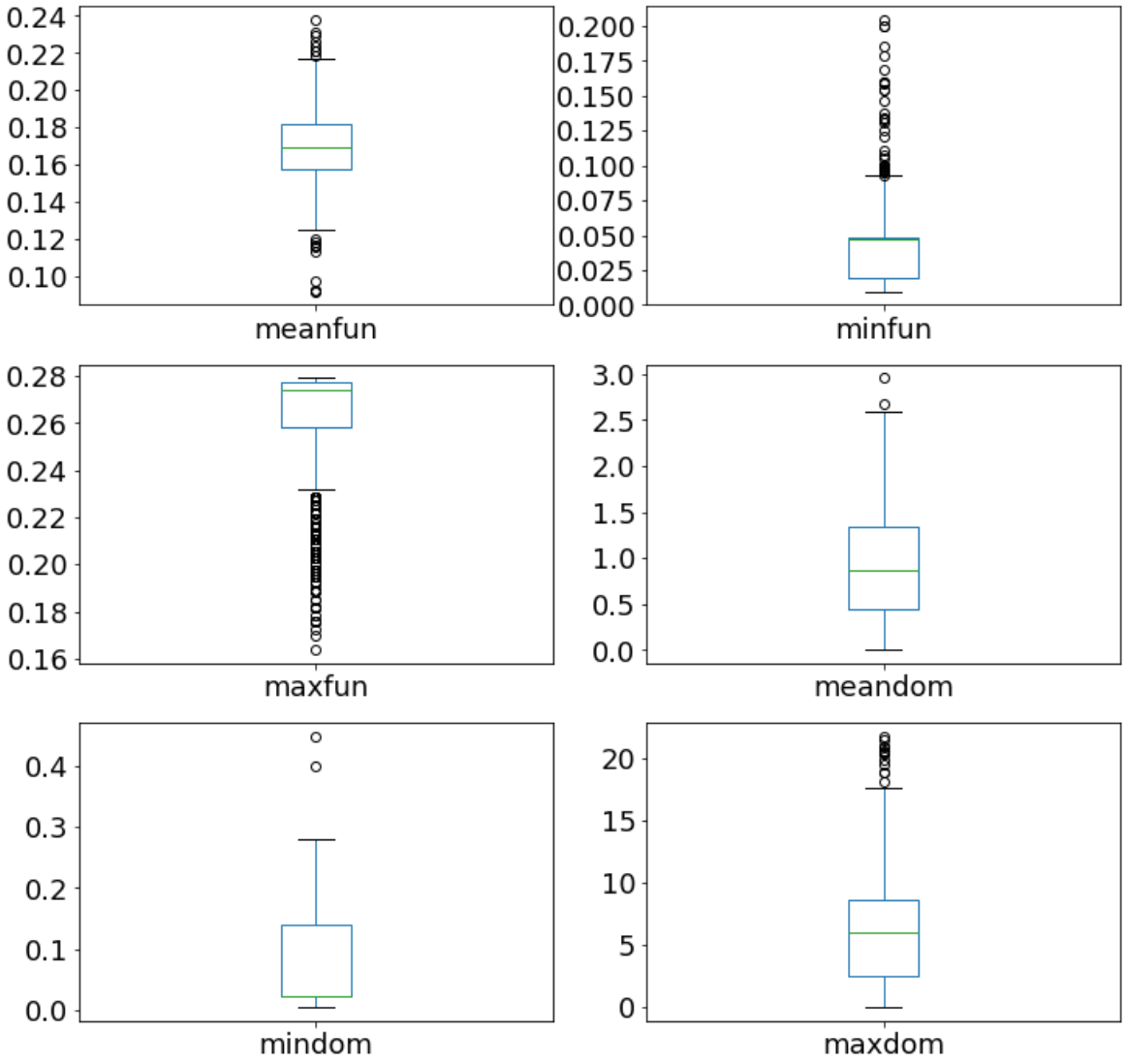
In [19]:

```
plt.rcParams['figure.figsize'] = (12,12)
dfMulheres[colunas[6:12]].plot(kind='box', subplots=True, layout=(3,2), sharex=False, sharey=
plt.show()
```



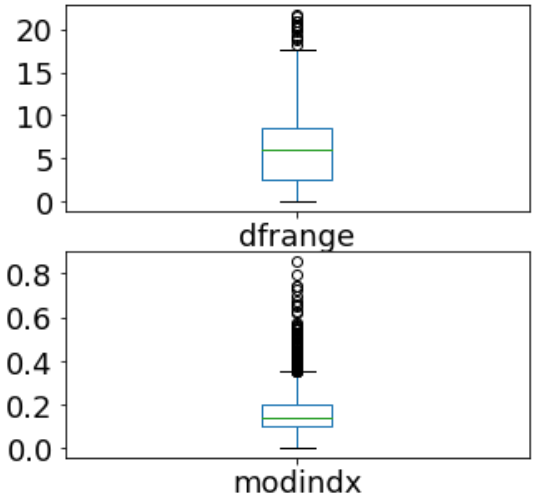
In [20]:

```
plt.rcParams['figure.figsize'] = (12,12)
dfMulheres[colunas[12:18]].plot(kind='box', subplots=True, layout=(3,2), sharex=False, sharey
plt.show()
```



In [21]:

```
plt.rcParams['figure.figsize'] = (5,5)
dfMulheres[colunas[18:20]].plot(kind='box', subplots=True, layout=(2,1), sharex=False, sharey
plt.show()
```

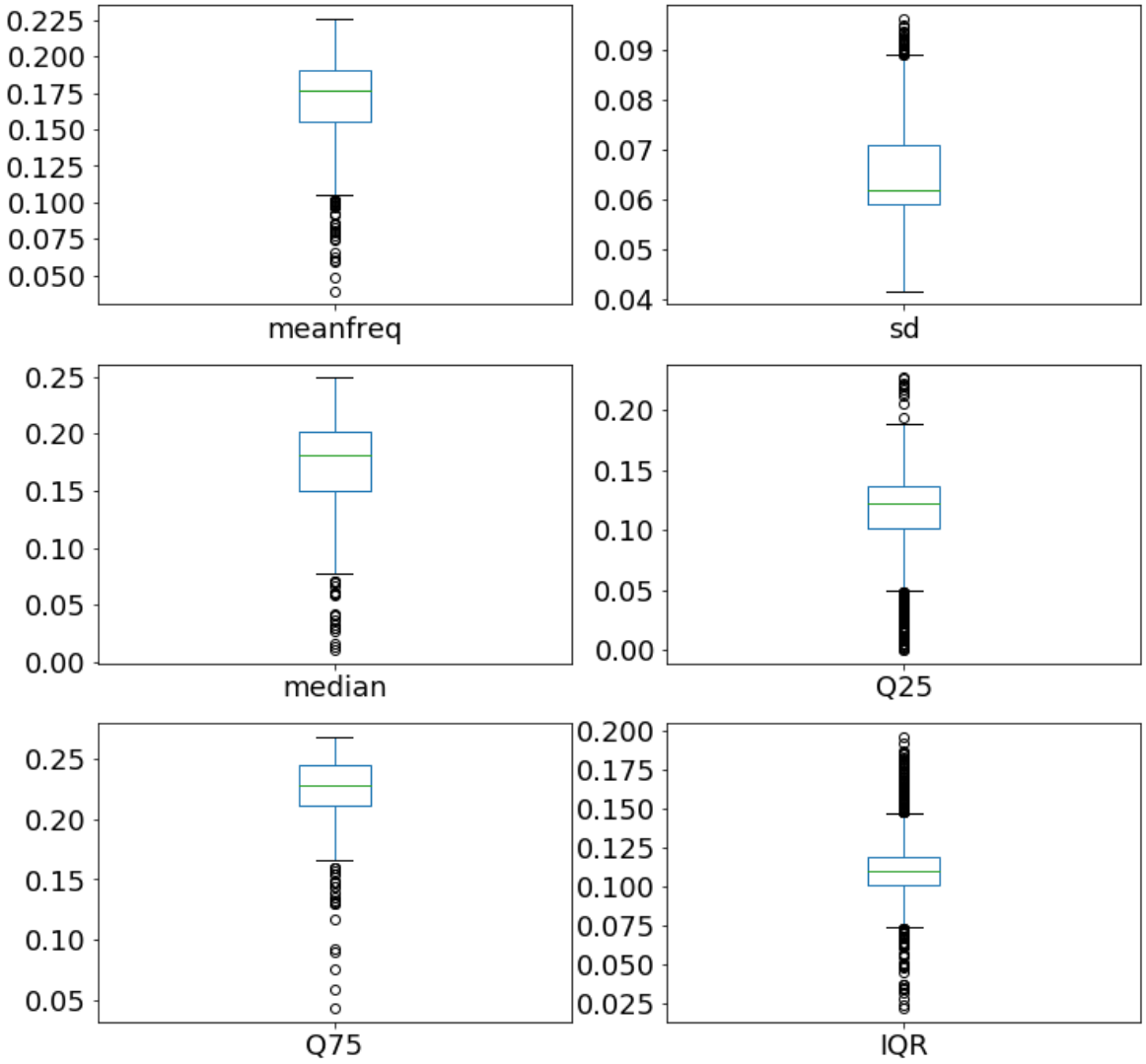


BOXPLOT vozes masculinas - Verificando discrepâncias

In [22]:

```
print(colunas)
plt.rcParams['figure.figsize'] = (12,12)
dfHomens[colunas[0:6]].plot(kind='box', subplots=True, layout=(3,2), sharex=False, sharey=Fal
plt.show()
```

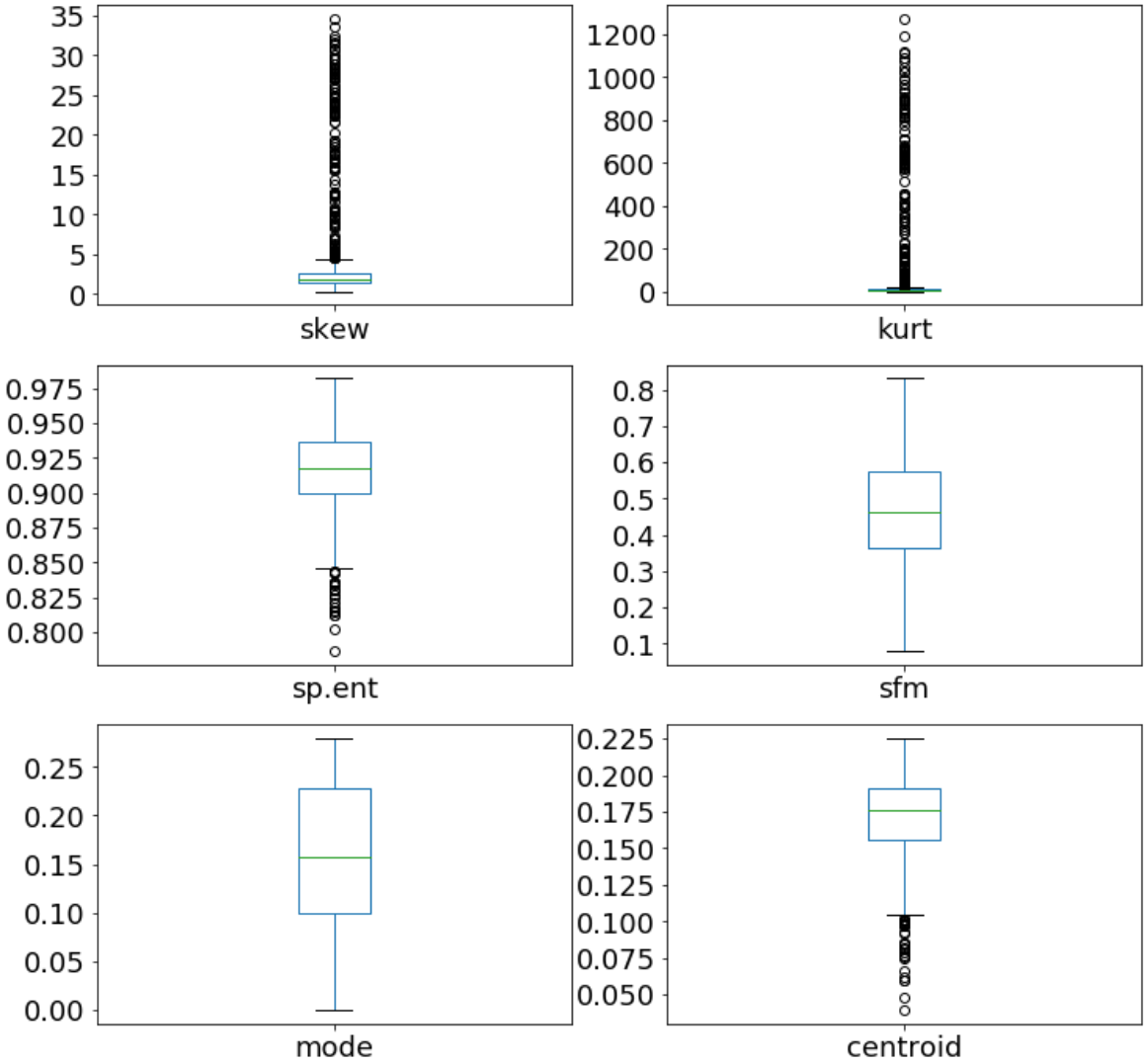
```
['meanfreq', 'sd', 'median', 'Q25', 'Q75', 'IQR', 'skew', 'kurt', 'sp.ent', 'sfm', 'mode',
'centroid', 'meanfun', 'minfun', 'maxfun', 'meandom', 'mindom', 'maxdom', 'dfrange', 'modind
x', 'label']
```



In [23]:

```
print(colunas)
plt.rcParams['figure.figsize'] = (12,12)
dfHomens[colunas[6:12]].plot(kind='box', subplots=True, layout=(3,2), sharex=False, sharey=Fa
plt.show()
```

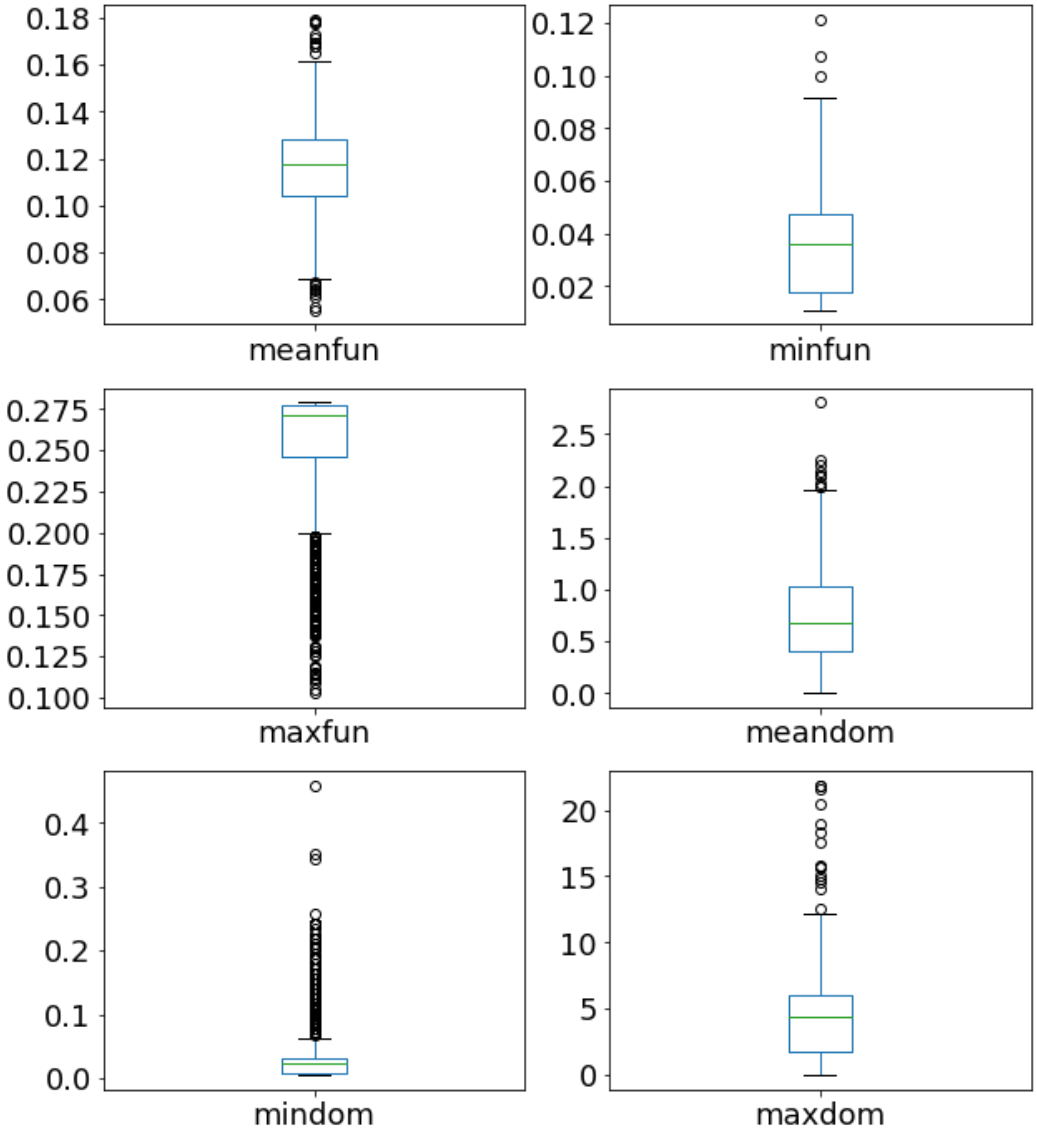
```
['meanfreq', 'sd', 'median', 'Q25', 'Q75', 'IQR', 'skew', 'kurt', 'sp.ent', 'sfm', 'mode',
'centroid', 'meanfun', 'minfun', 'maxfun', 'meandom', 'mindom', 'maxdom', 'dfrange', 'modind
x', 'label']
```



In [24]:

```
print(colunas)
plt.rcParams['figure.figsize'] = (10,12)
dfHomens[colunas[12:18]].plot(kind='box', subplots=True, layout=(3,2), sharex=False, sharey=F
plt.show()
```

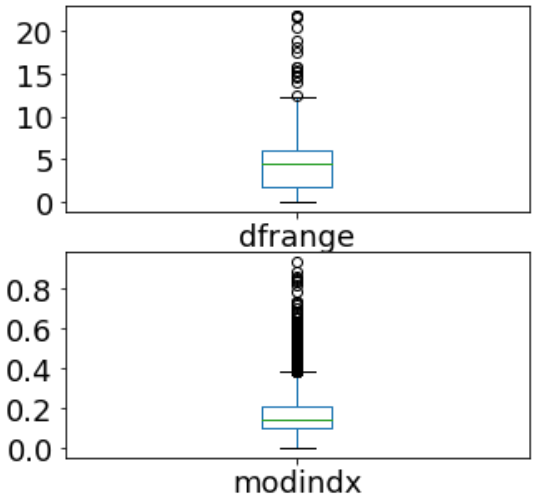
```
['meanfreq', 'sd', 'median', 'Q25', 'Q75', 'IQR', 'skew', 'kurt', 'sp.ent', 'sfm', 'mode',
'centroid', 'meanfun', 'minfun', 'maxfun', 'meandom', 'mindom', 'maxdom', 'dfrange', 'modind
x', 'label']
```



In [25]:

```
print(colunas)
plt.rcParams['figure.figsize'] = (5,5)
dfHomens[colunas[18:20]].plot(kind='box', subplots=True, layout=(2,1), sharex=False, sharey=F
plt.show()
```

```
['meanfreq', 'sd', 'median', 'Q25', 'Q75', 'IQR', 'skew', 'kurt', 'sp.ent', 'sfm', 'mode',
'centroid', 'meanfun', 'minfun', 'maxfun', 'meandom', 'mindom', 'maxdom', 'dfrange', 'modind
x', 'label']
```



Método de interquartil.

Definição 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.

Aplicando nos dados de vozes femininas, Técnica do Interquartil

In [26]:

```
dfgrafico_test = dfMulheres
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)) | (dfgr
        dfgrafico_test[y] = df_sem_Outliersx
```

```
c:\users\jorge\appdata\local\programs\python\python37-32\lib\site-packages\ipykernel_launche
r.py:11: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/user_guid
e/indexing.html#returning-a-view-versus-a-copy (http://pandas.pydata.org/pandas-docs/stable/
user_guide/indexing.html#returning-a-view-versus-a-copy)
  # This is added back by InteractiveShellApp.init_path()
```

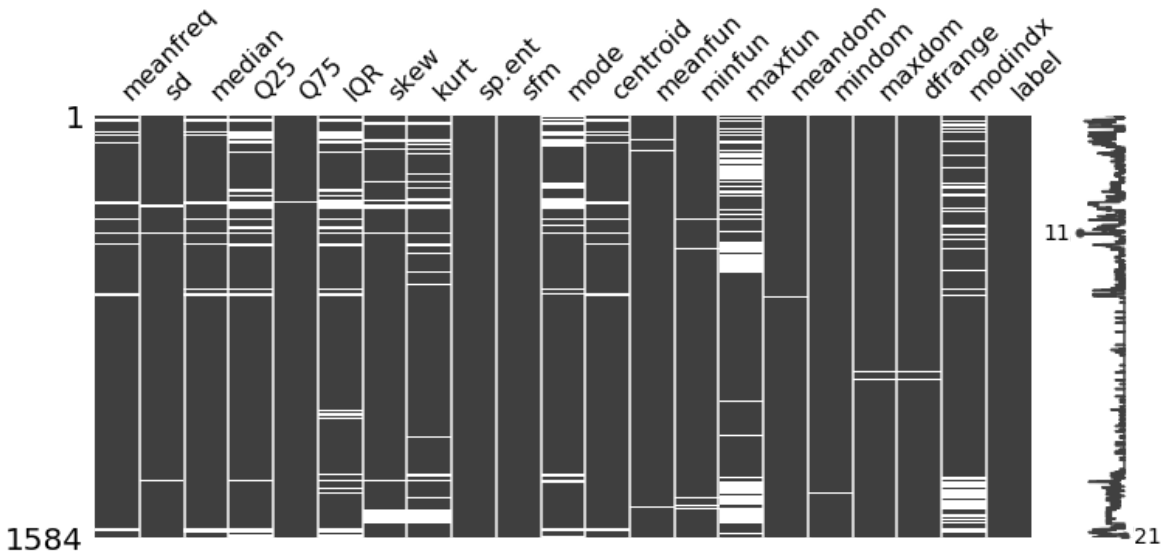
Imprime dados discrepantes removidos nos dados de vozes femininas

In [27]:

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

Out[27]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x1379f8d0>
```



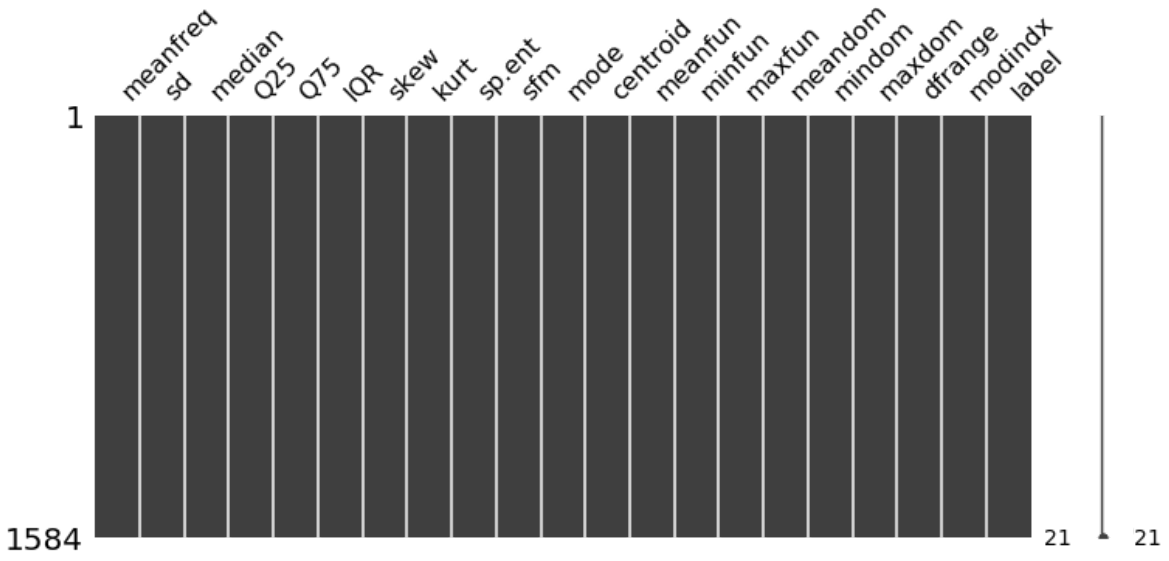
In [28]:
```
dfgrafico_test = dfMulheres
for z in range(0,NV):
    for y in colunas:
        if y == "label":
            continue
        Q1 = dfMulheres[y].quantile(0.25)
        Q3 = dfMulheres[y].quantile(0.75)
        IQR = Q3 - Q1
        df_sem_Outliersx = dfMulheres[y][~((dfMulheres[y] < (Q1 - 1.5 * IQR)) | (dfMulheres[y
        dfMulheres[y] = df_sem_Outliersx
        dfMulheres=dfMulheres.fillna(dfMulheres.mean())
```

```
c:\users\jorge\appdata\local\programs\python\python37-32\lib\site-packages\ipykernel_launche
r.py:10: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/user_guid
e/indexing.html#returning-a-view-versus-a-copy (http://pandas.pydata.org/pandas-docs/stable/
user_guide/indexing.html#returning-a-view-versus-a-copy)
  # Remove the CWD from sys.path while we load stuff.
```

In [29]:
```
### Imprime dados normalizados de vozes femininas
```

In [30]:
```
msno.matrix(dfMulheres,figsize=(12,5))
```

Out[30]:
```
<matplotlib.axes._subplots.AxesSubplot at 0x134b8dd0>
```



Aplicando nos dados de vozes masculinas, Técnica do Interquartil

In [31]:

```
dfgrafico_test = dfHomens
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)) | (dfgr
        dfgrafico_test[y] = df_sem_Outliersx
```

```
c:\users\jorge\appdata\local\programs\python\python37-32\lib\site-packages\ipykernel_launche
r.py:11: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/user_guid
e/indexing.html#returning-a-view-versus-a-copy (http://pandas.pydata.org/pandas-docs/stable/
user_guide/indexing.html#returning-a-view-versus-a-copy)
  # This is added back by InteractiveShellApp.init_path()
```

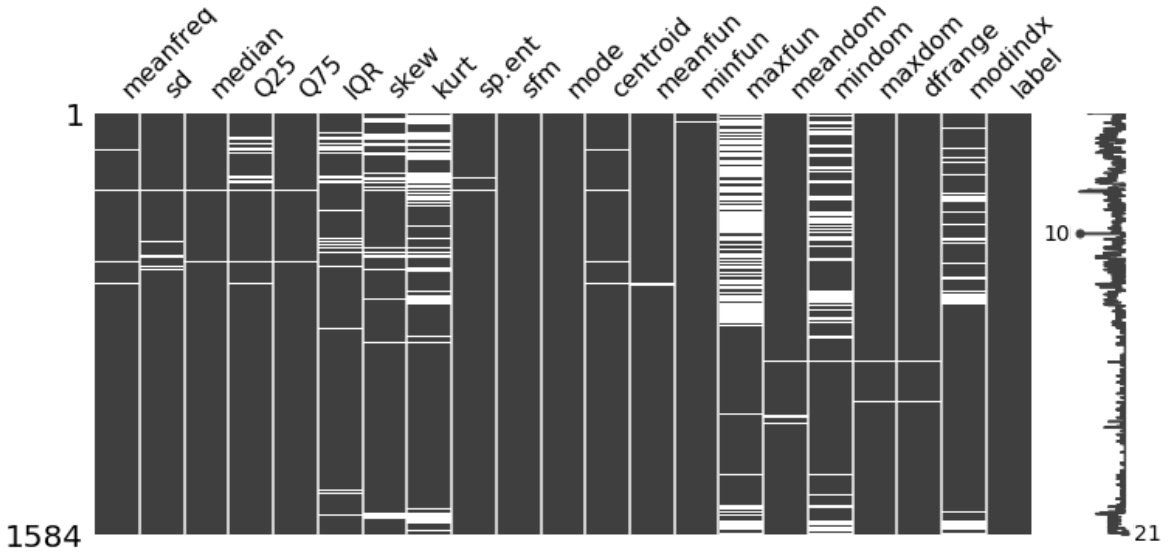
Imprime dados discrepantes removidos nos dados de vozes masculinas

In [32]:

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

Out[32]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x13342750>
```



In [33]:

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

```
c:\users\jorge\appdata\local\programs\python\python37-32\lib\site-packages\ipykernel_launche
r.py:10: SettingWithCopyWarning:
A value is trying to be set on a copy of a slice from a DataFrame.
Try using .loc[row_indexer,col_indexer] = value instead

See the caveats in the documentation: http://pandas.pydata.org/pandas-docs/stable/user_guid
e/indexing.html#returning-a-view-versus-a-copy (http://pandas.pydata.org/pandas-docs/stable/
user_guide/indexing.html#returning-a-view-versus-a-copy)
  # Remove the CWD from sys.path while we load stuff.
```

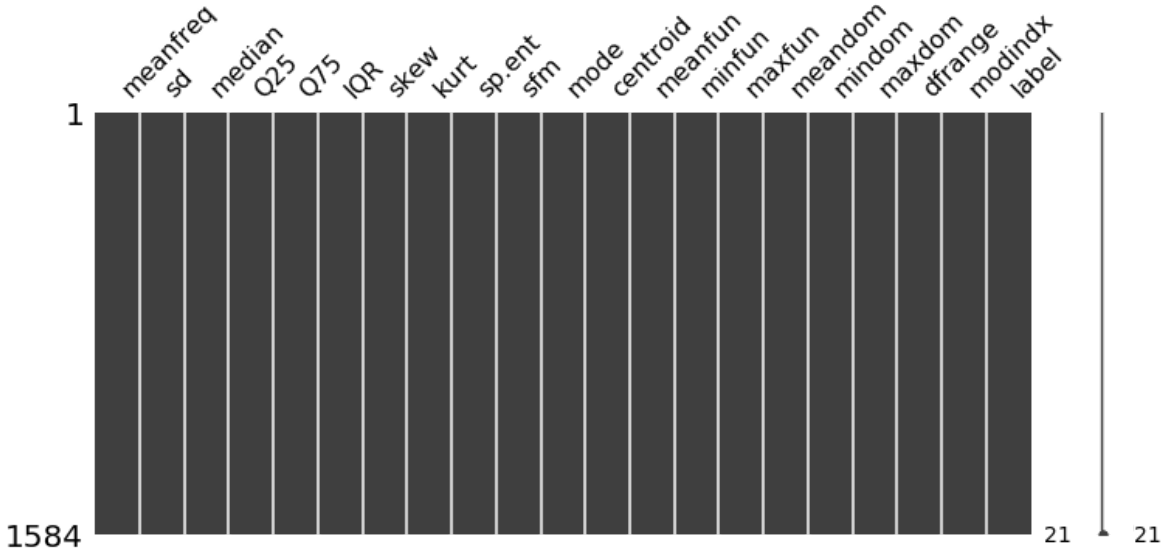
Imprime dados normalizados de vozes masculinas

In [34]:

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

Out[34]:

```
<matplotlib.axes._subplots.AxesSubplot at 0x139dd7f0>
```

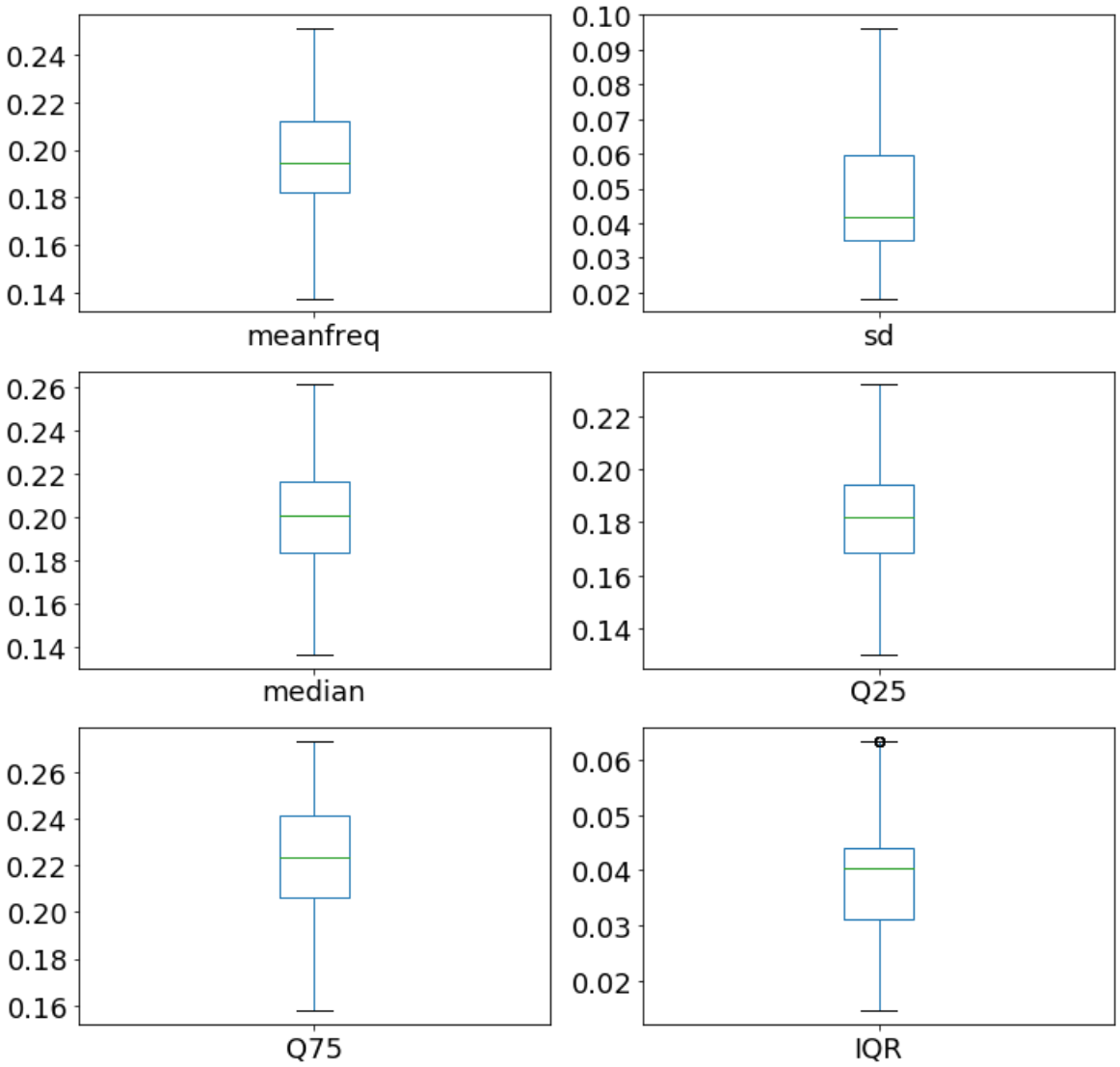


BOXPLOT vozes femininas

In [35]:

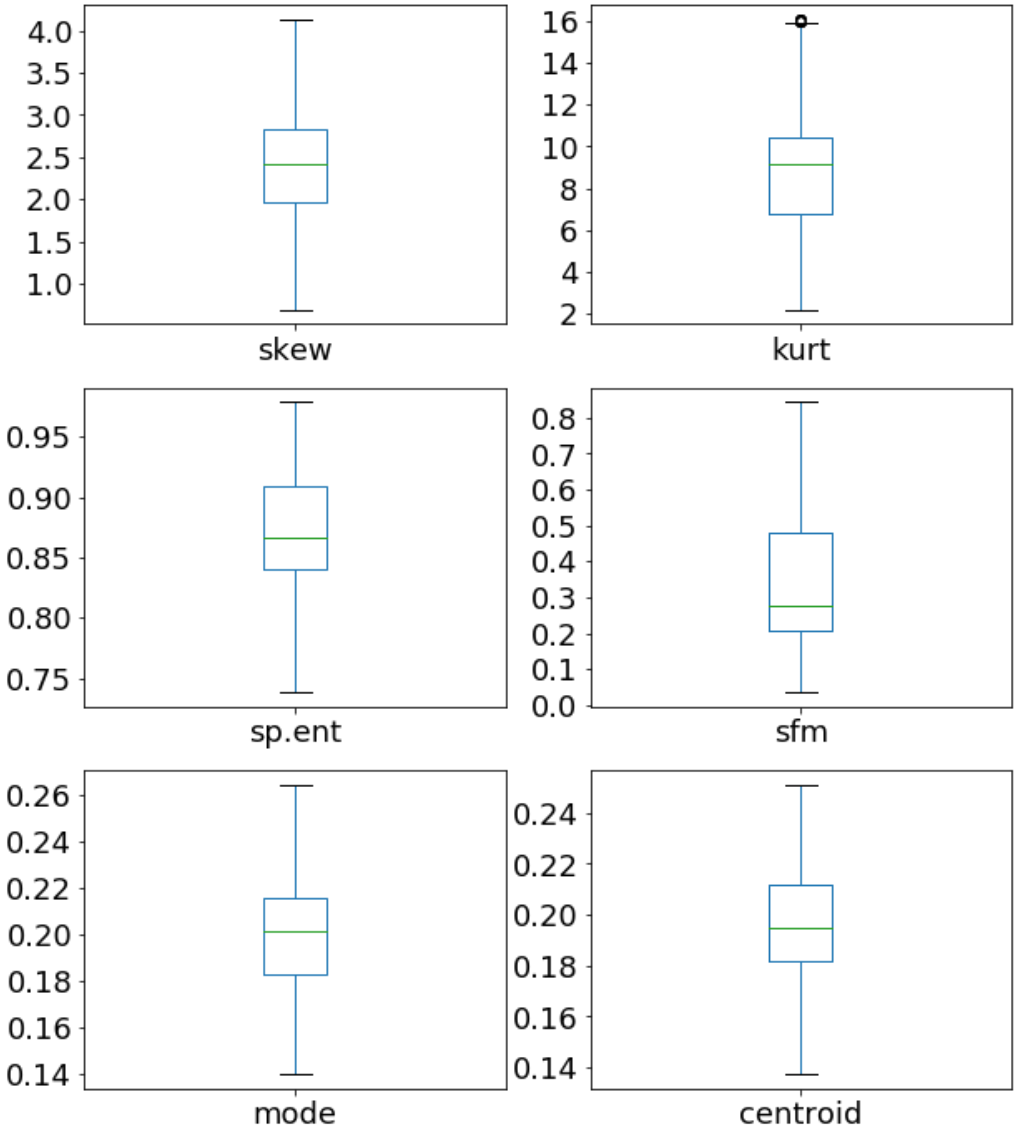
```
print(colunas)
plt.rcParams['figure.figsize'] = (12,12)
dfMulheres[colunas[0:6]].plot(kind='box', subplots=True, layout=(3,2), sharex=False, sharey=F
plt.show()
```

```
['meanfreq', 'sd', 'median', 'Q25', 'Q75', 'IQR', 'skew', 'kurt', 'sp.ent', 'sfm', 'mode',
'centroid', 'meanfun', 'minfun', 'maxfun', 'meandom', 'mindom', 'maxdom', 'dfrange', 'modind
x', 'label']
```



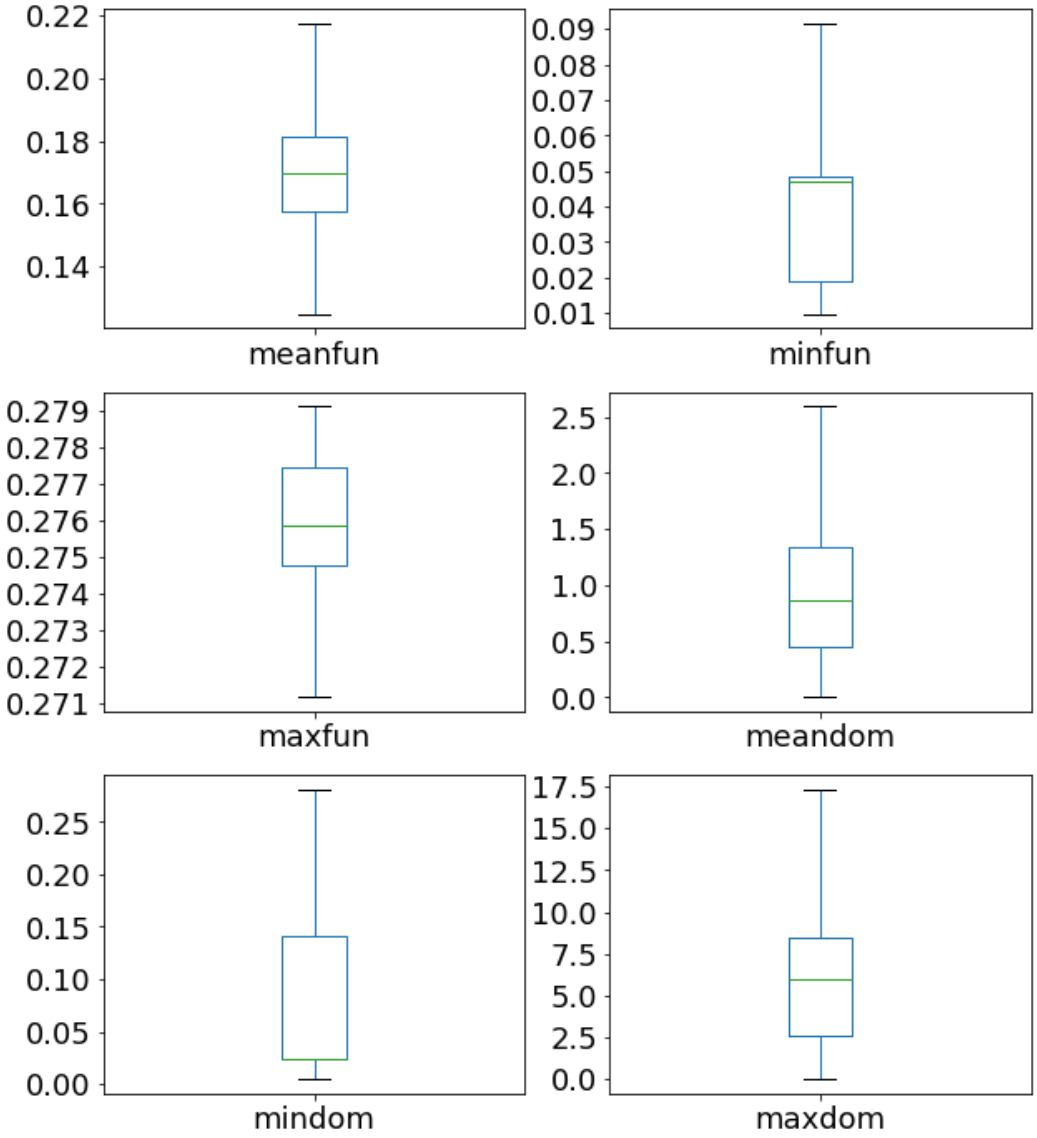
In [36]:

```
plt.rcParams['figure.figsize'] = (10,12)
dfMulheres[colunas[6:12]].plot(kind='box', subplots=True, layout=(3,2), sharex=False, sharey=
plt.show()
```



In [37]:

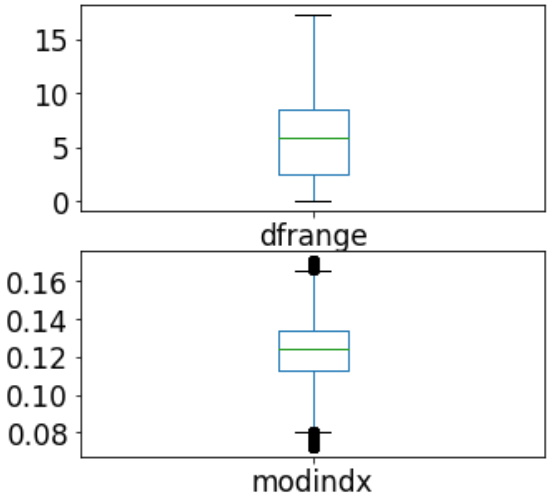
```
plt.rcParams['figure.figsize'] = (10,12)
dfMulheres[colunas[12:18]].plot(kind='box', subplots=True, layout=(3,2), sharex=False, sharey
plt.show()
```



In [38]:

```
print(colunas)
plt.rcParams['figure.figsize'] = (5,5)
dfMulheres[colunas[18:20]].plot(kind='box', subplots=True, layout=(2,1), sharex=False, sharey
plt.show()
```

```
['meanfreq', 'sd', 'median', 'Q25', 'Q75', 'IQR', 'skew', 'kurt', 'sp.ent', 'sfm', 'mode',
'centroid', 'meanfun', 'minfun', 'maxfun', 'meandom', 'mindom', 'maxdom', 'dfrange', 'modind
x', 'label']
```

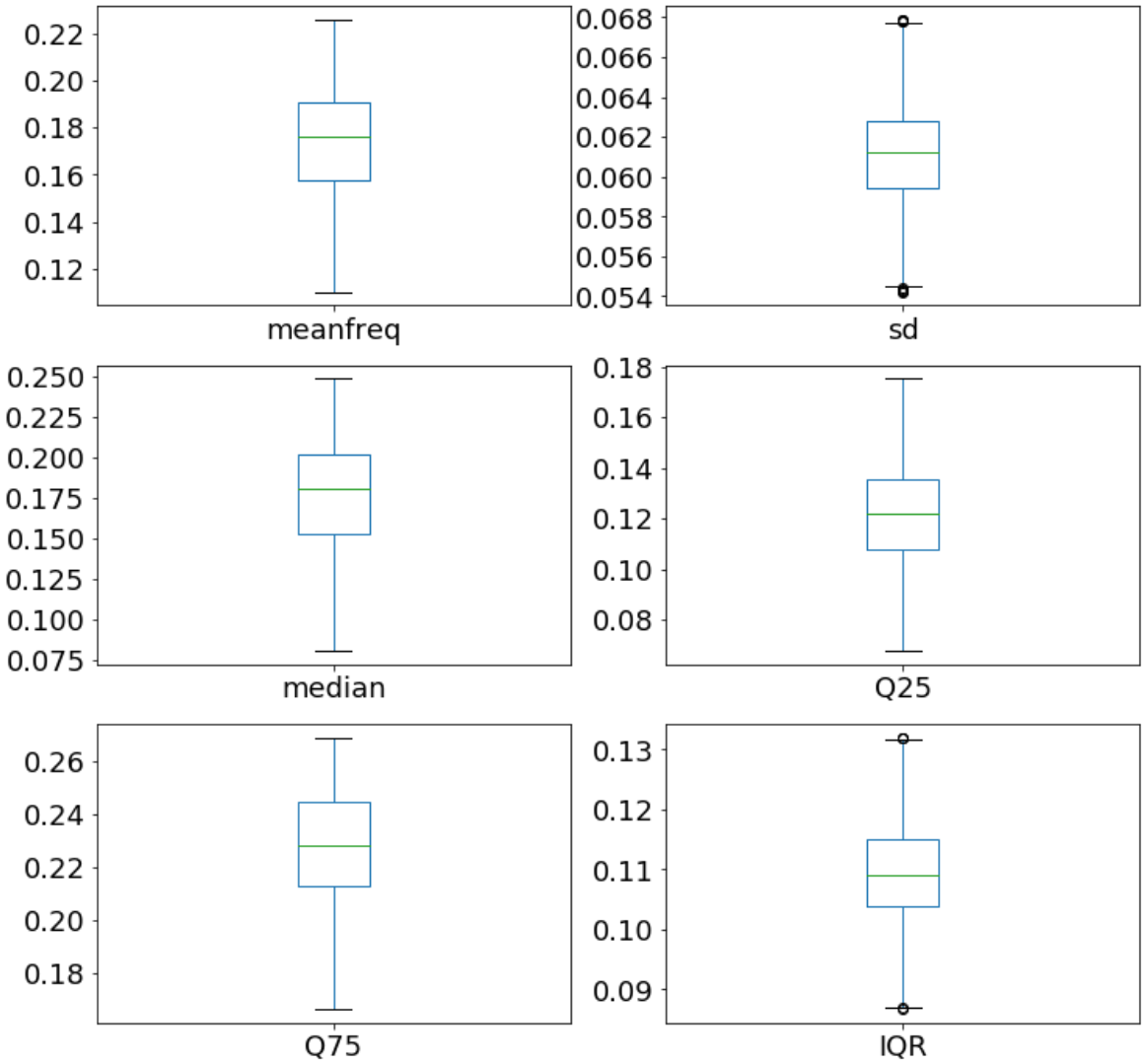


BOXPLOT vozes masculinas

In [39]:

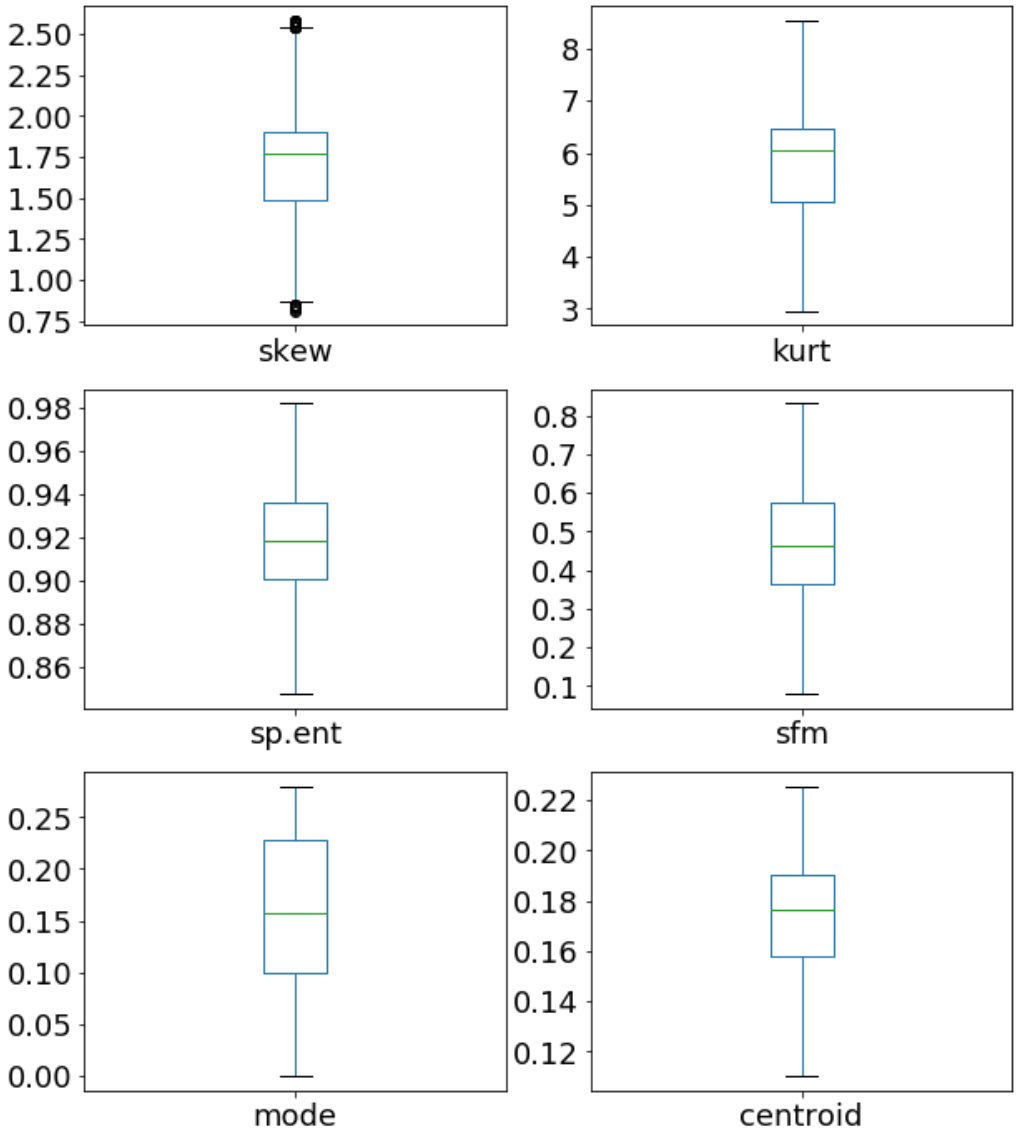
```
print(colunas)
plt.rcParams['figure.figsize'] = (12,12)
dfHomens[colunas[0:6]].plot(kind='box', subplots=True, layout=(3,2), sharex=False, sharey=Fal
plt.show()
```

```
['meanfreq', 'sd', 'median', 'Q25', 'Q75', 'IQR', 'skew', 'kurt', 'sp.ent', 'sfm', 'mode',
'centroid', 'meanfun', 'minfun', 'maxfun', 'meandom', 'mindom', 'maxdom', 'dfrange', 'modind
x', 'label']
```



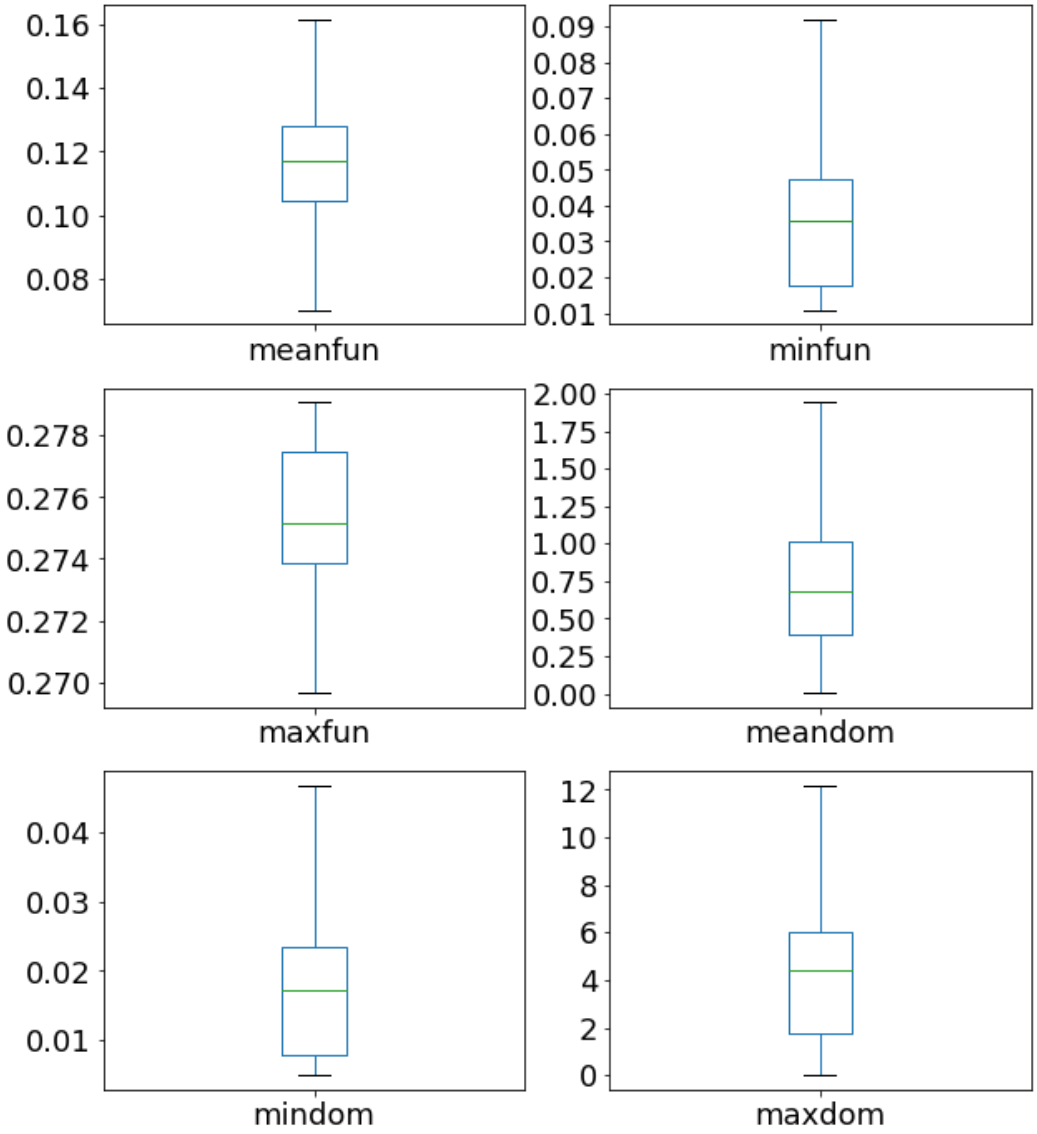
In [40]:

```
plt.rcParams['figure.figsize'] = (10,12)
dfHomens[colunas[6:12]].plot(kind='box', subplots=True, layout=(3,2), sharex=False, sharey=Fa
plt.show()
```



In [41]:

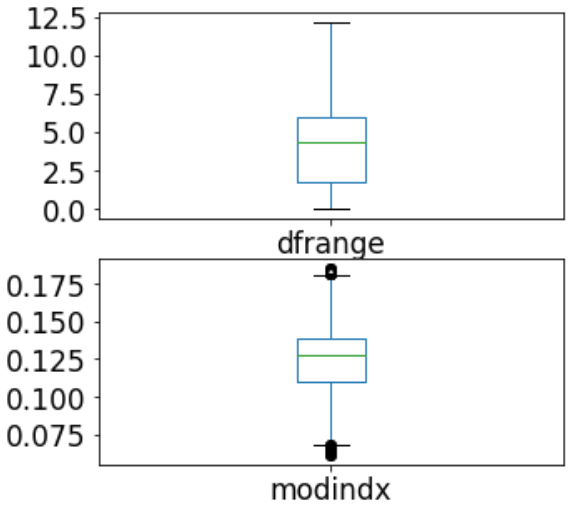
```
plt.rcParams['figure.figsize'] = (10,12)
dfHomens[colunas[12:18]].plot(kind='box', subplots=True, layout=(3,2), sharex=False, sharey=F
plt.show()
```



In [42]:

```
print(colunas)
plt.rcParams['figure.figsize'] = (5,5)
dfHomens[colunas[18:20]].plot(kind='box', subplots=True, layout=(2,1), sharex=False, sharey=F
plt.show()
```

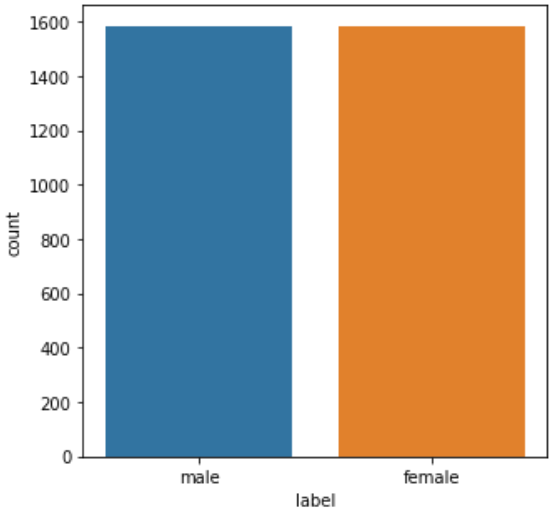
```
['meanfreq', 'sd', 'median', 'Q25', 'Q75', 'IQR', 'skew', 'kurt', 'sp.ent', 'sfm', 'mode',
'centroid', 'meanfun', 'minfun', 'maxfun', 'meandom', 'mindom', 'maxdom', 'dfrange', 'modind
x', 'label']
```



Juntando os dados vozes masculinas com femininas

In [43]:

```
frames = [dfHomens,dfMulheres]
dfresult = pandas.concat(frames)
sb.countplot('label',data=dfresult)
plt.rcParams['figure.figsize'] = (5,5)
plt.show()
```



Salvo o arquivo para modelos e para Rstudio

In [44]:
```
dfresult.to_csv(".\\baseDados\\voice_fix.csv", header=False, index=False)
dfresult.to_csv(".\\baseDados\\Rvoice_fix.csv", header=True, index=False)
```

Fim do pré-processamento

Analise exploratória

In [45]:
```
# Carrega os dados limpos
url = ".\\baseDados\\voice_fix.csv"
colunas = ["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","sfm","mode","ce
dataset = pandas.read_csv(url, names=colunas, sep = ",")
```

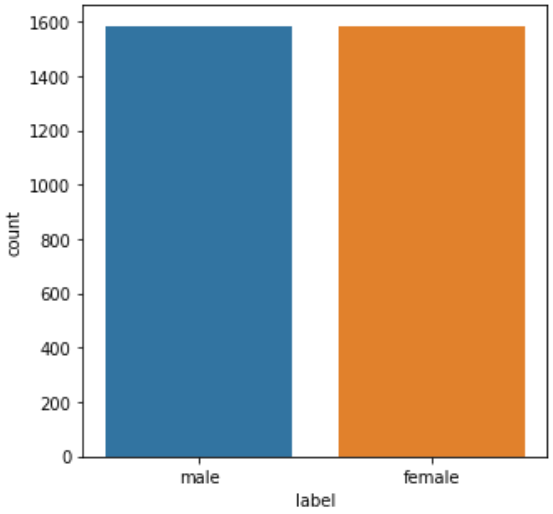
In [46]:
```
dataset.head()
```

Out[46]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt	sp.ent	sfm	...	centr
0	0.172557	0.064241	0.176893	0.121089	0.227842	0.109055	1.906048	6.450221	0.893369	0.491918	...	0.172
1	0.172557	0.067310	0.176893	0.121089	0.227842	0.109055	1.906048	6.450221	0.892193	0.513724	...	0.172
2	0.172557	0.063549	0.176893	0.121089	0.227842	0.123207	1.906048	6.450221	0.918553	0.478905	...	0.172
3	0.151228	0.061216	0.158011	0.096582	0.207955	0.111374	1.232831	4.177296	0.963322	0.727232	...	0.151
4	0.135120	0.062769	0.124656	0.078720	0.206045	0.127325	1.101174	4.333713	0.971955	0.783568	...	0.135

5 rows × 21 columns

In [47]:
```
sb.countplot('label',data=dataset)
plt.rcParams['figure.figsize'] = (5,5)
plt.show()
```



Estatística descritiva

In [48]:
```
dataset.describe()
```

Out[48]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt
count	3168.000000	3168.000000	3168.000000	3168.000000	3168.000000	3168.000000	3168.000000	3168.000000
mean	0.184297	0.054831	0.188770	0.151886	0.225699	0.074269	2.068316	7.398229
std	0.025580	0.013947	0.031509	0.036212	0.021551	0.036409	0.635557	2.746346
min	0.110311	0.018363	0.080672	0.067763	0.157750	0.014558	0.692271	2.209673
25%	0.168020	0.041967	0.172628	0.121645	0.209410	0.040331	1.661839	5.710629
50%	0.186479	0.059525	0.191252	0.149349	0.226274	0.075076	1.906048	6.450221
75%	0.199146	0.062449	0.210618	0.181927	0.243660	0.109055	2.428321	9.157991
max	0.251124	0.096062	0.261224	0.231776	0.273469	0.131996	4.124850	16.052840

In [49]:
```
pandas.set_option('display.width', 100)
pandas.set_option('precision', 3)
resultado = dataset.describe()
print(resultado)
```

```
       meanfreq         sd     median        Q25        Q75        IQR       skew       kurt     sp.
ent  \
count  3168.000  3168.000  3168.000  3168.000  3168.000  3168.000  3168.000  3168.000  3168.
000
mean      0.184     0.055     0.189     0.152     0.226     0.074     2.068     7.398     0.
896
std       0.026     0.014     0.032     0.036     0.022     0.036     0.636     2.746     0.
045
min       0.110     0.018     0.081     0.068     0.158     0.015     0.692     2.210     0.
739
25%       0.168     0.042     0.173     0.122     0.209     0.040     1.662     5.711     0.
863
50%       0.186     0.060     0.191     0.149     0.226     0.075     1.906     6.450     0.
903
75%       0.199     0.062     0.211     0.182     0.244     0.109     2.428     9.158     0.
929
max       0.251     0.096     0.261     0.232     0.273     0.132     4.125    16.053     0.
982

             sfm      mode  centroid   meanfun    minfun    maxfun   meandom    mindom     max
dom  \
count  3168.000  3168.000  3168.000  3168.000  3168.000  3168.000  3168.000  3168.000  3168.
000
mean      0.408     0.176     0.184     0.143     0.036     0.276     0.823     0.041     4.
922
std       0.178     0.067     0.026     0.032     0.016     0.002     0.517     0.056     3.
263
min       0.037     0.000     0.110     0.070     0.010     0.270     0.008     0.005     0.
008
25%       0.258     0.148     0.168     0.117     0.018     0.274     0.420     0.008     2.
070
50%       0.396     0.196     0.186     0.140     0.043     0.275     0.760     0.023     4.
953
75%       0.534     0.219     0.199     0.170     0.048     0.277     1.168     0.023     6.
984
max       0.843     0.280     0.251     0.217     0.092     0.279     2.592     0.281    17.
344

        dfrange   modindx
count  3168.000  3168.000
mean      4.870     0.124
std       3.262     0.023
min       0.000     0.061
25%       2.045     0.112
50%       4.922     0.126
75%       6.906     0.135
max      17.320     0.185
```

Rotaciona a tabela descritiva

In [50]:
```
dataset.describe().transpose()
```

Out[50]:

	count	mean	std	min	25%	50%	75%	max
meanfreq	3168.0	0.184	0.026	0.110	0.168	0.186	0.199	0.251
sd	3168.0	0.055	0.014	0.018	0.042	0.060	0.062	0.096
median	3168.0	0.189	0.032	0.081	0.173	0.191	0.211	0.261
Q25	3168.0	0.152	0.036	0.068	0.122	0.149	0.182	0.232
Q75	3168.0	0.226	0.022	0.158	0.209	0.226	0.244	0.273
IQR	3168.0	0.074	0.036	0.015	0.040	0.075	0.109	0.132
skew	3168.0	2.068	0.636	0.692	1.662	1.906	2.428	4.125
kurt	3168.0	7.398	2.746	2.210	5.711	6.450	9.158	16.053
sp.ent	3168.0	0.896	0.045	0.739	0.863	0.903	0.929	0.982
sfm	3168.0	0.408	0.178	0.037	0.258	0.396	0.534	0.843
mode	3168.0	0.176	0.067	0.000	0.148	0.196	0.219	0.280
centroid	3168.0	0.184	0.026	0.110	0.168	0.186	0.199	0.251
meanfun	3168.0	0.143	0.032	0.070	0.117	0.140	0.170	0.217
minfun	3168.0	0.036	0.016	0.010	0.018	0.043	0.048	0.092
maxfun	3168.0	0.276	0.002	0.270	0.274	0.275	0.277	0.279
meandom	3168.0	0.823	0.517	0.008	0.420	0.760	1.168	2.592
mindom	3168.0	0.041	0.056	0.005	0.008	0.023	0.023	0.281
maxdom	3168.0	4.922	3.263	0.008	2.070	4.953	6.984	17.344
dfrange	3168.0	4.870	3.262	0.000	2.045	4.922	6.906	17.320
modindx	3168.0	0.124	0.023	0.061	0.112	0.126	0.135	0.185

In [51]:
```
print(dataset.describe().transpose())
```

```
           count   mean    std    min    25%    50%    75%     max
meanfreq  3168.0  0.184  0.026  0.110  0.168  0.186  0.199   0.251
sd        3168.0  0.055  0.014  0.018  0.042  0.060  0.062   0.096
median    3168.0  0.189  0.032  0.081  0.173  0.191  0.211   0.261
Q25       3168.0  0.152  0.036  0.068  0.122  0.149  0.182   0.232
Q75       3168.0  0.226  0.022  0.158  0.209  0.226  0.244   0.273
IQR       3168.0  0.074  0.036  0.015  0.040  0.075  0.109   0.132
skew      3168.0  2.068  0.636  0.692  1.662  1.906  2.428   4.125
kurt      3168.0  7.398  2.746  2.210  5.711  6.450  9.158  16.053
sp.ent    3168.0  0.896  0.045  0.739  0.863  0.903  0.929   0.982
sfm       3168.0  0.408  0.178  0.037  0.258  0.396  0.534   0.843
mode      3168.0  0.176  0.067  0.000  0.148  0.196  0.219   0.280
centroid  3168.0  0.184  0.026  0.110  0.168  0.186  0.199   0.251
meanfun   3168.0  0.143  0.032  0.070  0.117  0.140  0.170   0.217
minfun    3168.0  0.036  0.016  0.010  0.018  0.043  0.048   0.092
maxfun    3168.0  0.276  0.002  0.270  0.274  0.275  0.277   0.279
meandom   3168.0  0.823  0.517  0.008  0.420  0.760  1.168   2.592
mindom    3168.0  0.041  0.056  0.005  0.008  0.023  0.023   0.281
maxdom    3168.0  4.922  3.263  0.008  2.070  4.953  6.984  17.344
dfrange   3168.0  4.870  3.262  0.000  2.045  4.922  6.906  17.320
modindx   3168.0  0.124  0.023  0.061  0.112  0.126  0.135   0.185
```

Em nossos dados existe apenas um variável *label* que é Qualitativa Nominal sendo que demais são quantitativas contínuas

In [52]:

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

print(A)
```

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

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

MEDIDAS DE POSIÇÃO, já estão calculados na tabela *describe* Media , Percentis, Quartis

Mediana e a mesma medias 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.

Vamos calcular moda.

Moda

In [53]:

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

In [54]:

```
### Calculado a moda  e armazenando em dicionário.
```

In [55]:

```
print(Modadic)
print(Medianaadic)
```

```
{'meanfreq': 0.19472718236502165, 'sd': 0.061608105708484566, 'median': 0.20054250178697985,
'Q25': 0.1819274845526179, 'Q75': 0.22784220505424035, 'IQR': 0.041269320645700366, 'skew':
1.9060477321644864, 'kurt': 6.450221192869066, 'sp.ent': 0.9184162126645676, 'sfm': 0.084934
3635514977, 'mode': 0.20183441212714168, 'centroid': 0.19472718236502165, 'meanfun': 0.11577
965623313086, 'minfun': 0.0469208211143695, 'maxfun': 0.2738630053699619, 'meandom': 0.00781
25, 'mindom': 0.0234375, 'maxdom': 0.0078125, 'dfrange': 0.0, 'modindx': 0.1339314466027107
8}
{'meanfreq': 0.18647868939908246, 'sd': 0.0595253461221969, 'median': 0.19125166792965048,
'Q25': 0.149349342481418, 'Q75': 0.226274112408729, 'IQR': 0.07507567046154351, 'skew': 1.90
60477321644864, 'kurt': 6.450221192869066, 'sp.ent': 0.902573495041479, 'sfm': 0.39633515683
2049, 'mode': 0.195616438356164, 'centroid': 0.18647868939908246, 'meanfun': 0.1404994432254
3, 'minfun': 0.043340334680360554, 'maxfun': 0.2751664350544543, 'meandom': 0.75952380952380
95, 'mindom': 0.0234375, 'maxdom': 4.953125, 'dfrange': 4.921875, 'modindx': 0.1258743649411
3735}
```

In [56]:

```
### Transformando  os resultados em data frame.
```

In [57]:

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

Out[57]:

	quantitativas	moda
0	meanfreq	0.195
1	sd	0.062
2	median	0.201
3	Q25	0.182
4	Q75	0.228
5	IQR	0.041
6	skew	1.906
7	kurt	6.450
8	sp.ent	0.918
9	sfm	0.085
10	mode	0.202
11	centroid	0.195
12	meanfun	0.116
13	minfun	0.047
14	maxfun	0.274
15	meandom	0.008
16	mindom	0.023
17	maxdom	0.008
18	dfrange	0.000
19	modindx	0.134

In [58]:
```
dfmediana = pandas.DataFrame.from_dict(Medianaadic, orient="index").reset_index()
dfmediana.columns = ["quantitativas","mediana"]
dfmediana.head()
```

Out[58]:

	quantitativas	mediana
0	meanfreq	0.186
1	sd	0.060
2	median	0.191
3	Q25	0.149
4	Q75	0.226

In [59]:
```
### usado para unir os dataframes.
df50porcento = pandas.DataFrame.from_dict(Medianaadic, orient="index").reset_index()
df50porcento.columns = ["quantitativas","50%"]
df50porcento.head()
```

Out[59]:

	quantitativas	50%
0	meanfreq	0.186
1	sd	0.060
2	median	0.191
3	Q25	0.149
4	Q75	0.226

In [60]:
```

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

In [61]:
```
print(dfmediaModa)
```

```
   quantitativas   moda  mediana    50%
0       meanfreq  0.195    0.186  0.186
1             sd  0.062    0.060  0.060
2         median  0.201    0.191  0.191
3            Q25  0.182    0.149  0.149
4            Q75  0.228    0.226  0.226
5            IQR  0.041    0.075  0.075
6           skew  1.906    1.906  1.906
7           kurt  6.450    6.450  6.450
8         sp.ent  0.918    0.903  0.903
9            sfm  0.085    0.396  0.396
10          mode  0.202    0.196  0.196
11      centroid  0.195    0.186  0.186
12       meanfun  0.116    0.140  0.140
13        minfun  0.047    0.043  0.043
14        maxfun  0.274    0.275  0.275
15       meandom  0.008    0.760  0.760
16        mindom  0.023    0.023  0.023
17        maxdom  0.008    4.953  4.953
18       dfrange  0.000    4.922  4.922
19       modindx  0.134    0.126  0.126
```

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

Amplitude.

-

In [62]:
```
print(dataset['meanfreq'].max() - dataset['meanfreq'].min())
```

```
0.14081306990041098
```

Variância.

In [63]:
```
print(dataset['meanfreq'].var())
```

```
0.0006543292219937714
```

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 [64]:
```
print(   (dataset['meanfreq'].std()/dataset['meanfreq'].mean()) *  100      )
```

```
13.879693499114708
```

Intervalo-Interquartil.

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

In [65]:
```
print(dataset['meanfreq'].quantile(q=0.75))
```

```
0.1991460508962063
```

In [66]:
```
print(dataset['meanfreq'].quantile(q=0.25))
```

```
0.16801958856648527
```

In [67]:
```
print(dataset['meanfreq'].quantile(q=0.75) - dataset['meanfreq'].quantile(q=0.25))
```

```
0.031126462329721022
```

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

In [68]:
```
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)
```

Transformando os resultados em dataframe.

In [69]:
```
dfAmplitude = pandas.DataFrame.from_dict(Amplitudedic, orient="index").reset_index()
dfAmplitude.columns = ["quantitativas","Amplitude"]
dfAmplitude.head()
```

Out[69]:

	quantitativas	Amplitude
0	meanfreq	0.141
1	sd	0.078
2	median	0.181
3	Q25	0.164
4	Q75	0.116

In [70]:
```
dfVariancia = pandas.DataFrame.from_dict(Varianciadic, orient="index").reset_index()
dfVariancia.columns = ["quantitativas","Variancia"]
dfVariancia.head()
```

Out[70]:

	quantitativas	Variancia
0	meanfreq	6.543e-04
1	sd	1.945e-04
2	median	9.928e-04
3	Q25	1.311e-03
4	Q75	4.645e-04

In [71]:
```
dfCoeficiente = pandas.DataFrame.from_dict(CoeficienteVardic, orient="index").reset_index()
dfCoeficiente.columns = ["quantitativas","Coef_Var_%"]
dfCoeficiente.head()
```

Out[71]:

	quantitativas	Coef_Var_%
0	meanfreq	13.880
1	sd	25.437
2	median	16.692
3	Q25	23.842
4	Q75	9.549

In [72]:
```
IntervaloInterquartil = pandas.DataFrame.from_dict(IntervaloInterquartildic, orient="index").
IntervaloInterquartil.columns = ["quantitativas","Intervalo_Interquartil"]
IntervaloInterquartil.head()
```

Out[72]:

	quantitativas	Intervalo_Interquartil
0	meanfreq	0.031
1	sd	0.020
2	median	0.038
3	Q25	0.060
4	Q75	0.034

Mesclando os resultados.

In [73]:

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

```
   quantitativas  Amplitude  Variancia  Coef_Var_%  Intervalo_Interquartil
0       meanfreq      0.141  6.543e-04      13.880                   0.031
1             sd      0.078  1.945e-04      25.437                   0.020
2         median      0.181  9.928e-04      16.692                   0.038
3            Q25      0.164  1.311e-03      23.842                   0.060
4            Q75      0.116  4.645e-04       9.549                   0.034
5            IQR      0.117  1.326e-03      49.023                   0.069
6           skew      3.433  4.039e-01      30.728                   0.766
7           kurt     13.843  7.542e+00      37.122                   3.447
8         sp.ent      0.243  1.991e-03       4.981                   0.066
9            sfm      0.806  3.151e-02      43.487                   0.276
10          mode      0.280  4.442e-03      37.779                   0.071
11      centroid      0.141  6.543e-04      13.880                   0.031
12       meanfun      0.147  1.007e-03      22.223                   0.053
13        minfun      0.082  2.529e-04      44.544                   0.030
14        maxfun      0.009  5.125e-06       0.822                   0.004
15       meandom      2.584  2.672e-01      62.801                   0.748
16        mindom      0.276  3.154e-03     137.557                   0.016
17        maxdom     17.336  1.065e+01      66.290                   4.914
18       dfrange     17.320  1.064e+01      66.985                   4.861
19       modindx      0.124  5.403e-04      18.771                   0.024
```

Out[73]:

	quantitativas	Amplitude	Variancia	Coef_Var_%	Intervalo_Interquartil
0	meanfreq	0.141	6.543e-04	13.880	0.031
1	sd	0.078	1.945e-04	25.437	0.020
2	median	0.181	9.928e-04	16.692	0.038
3	Q25	0.164	1.311e-03	23.842	0.060
4	Q75	0.116	4.645e-04	9.549	0.034
5	IQR	0.117	1.326e-03	49.023	0.069
6	skew	3.433	4.039e-01	30.728	0.766
7	kurt	13.843	7.542e+00	37.122	3.447
8	sp.ent	0.243	1.991e-03	4.981	0.066
9	sfm	0.806	3.151e-02	43.487	0.276
10	mode	0.280	4.442e-03	37.779	0.071
11	centroid	0.141	6.543e-04	13.880	0.031
12	meanfun	0.147	1.007e-03	22.223	0.053
13	minfun	0.082	2.529e-04	44.544	0.030
14	maxfun	0.009	5.125e-06	0.822	0.004
15	meandom	2.584	2.672e-01	62.801	0.748
16	mindom	0.276	3.154e-03	137.557	0.016
17	maxdom	17.336	1.065e+01	66.290	4.914
18	dfrange	17.320	1.064e+01	66.985	4.861
19	modindx	0.124	5.403e-04	18.771	0.024

Mesclando os resultados com tabela de resumo estatístico.

In [74]:

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


dados_estatisticos=pandas.merge(dados_estatisticos,dfresultado_frame,how='right',on='quantita
#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    min    25%    75%     max
0       meanfreq  0.195    0.186  0.186  3168.0  0.184  0.026  0.110  0.168  0.199   0.251
1       centroid  0.195    0.186  0.186  3168.0  0.184  0.026  0.110  0.168  0.199   0.251
2       meanfreq  0.195    0.186  0.186  3168.0  0.184  0.026  0.110  0.168  0.199   0.251
3       centroid  0.195    0.186  0.186  3168.0  0.184  0.026  0.110  0.168  0.199   0.251
4             sd  0.062    0.060  0.060  3168.0  0.055  0.014  0.018  0.042  0.062   0.096
5         median  0.201    0.191  0.191  3168.0  0.189  0.032  0.081  0.173  0.211   0.261
6            Q25  0.182    0.149  0.149  3168.0  0.152  0.036  0.068  0.122  0.182   0.232
7            Q75  0.228    0.226  0.226  3168.0  0.226  0.022  0.158  0.209  0.244   0.273
8            IQR  0.041    0.075  0.075  3168.0  0.074  0.036  0.015  0.040  0.109   0.132
9           skew  1.906    1.906  1.906  3168.0  2.068  0.636  0.692  1.662  2.428   4.125
10          kurt  6.450    6.450  6.450  3168.0  7.398  2.746  2.210  5.711  9.158  16.053
11        sp.ent  0.918    0.903  0.903  3168.0  0.896  0.045  0.739  0.863  0.929   0.982
12           sfm  0.085    0.396  0.396  3168.0  0.408  0.178  0.037  0.258  0.534   0.843
13          mode  0.202    0.196  0.196  3168.0  0.176  0.067  0.000  0.148  0.219   0.280
14       meanfun  0.116    0.140  0.140  3168.0  0.143  0.032  0.070  0.117  0.170   0.217
15        minfun  0.047    0.043  0.043  3168.0  0.036  0.016  0.010  0.018  0.048   0.092
16        maxfun  0.274    0.275  0.275  3168.0  0.276  0.002  0.270  0.274  0.277   0.279
17       meandom  0.008    0.760  0.760  3168.0  0.823  0.517  0.008  0.420  1.168   2.592
18        mindom  0.023    0.023  0.023  3168.0  0.041  0.056  0.005  0.008  0.023   0.281
19        maxdom  0.008    4.953  4.953  3168.0  4.922  3.263  0.008  2.070  6.984  17.344
20       dfrange  0.000    4.922  4.922  3168.0  4.870  3.262  0.000  2.045  6.906  17.320
21       modindx  0.134    0.126  0.126  3168.0  0.124  0.023  0.061  0.112  0.135   0.185
   quantitativas   moda  mediana    50%   count   mean    std    min    25%    75%     max
\
0       meanfreq  0.195    0.186  0.186  3168.0  0.184  0.026  0.110  0.168  0.199   0.251
1       meanfreq  0.195    0.186  0.186  3168.0  0.184  0.026  0.110  0.168  0.199   0.251
2       centroid  0.195    0.186  0.186  3168.0  0.184  0.026  0.110  0.168  0.199   0.251
3       centroid  0.195    0.186  0.186  3168.0  0.184  0.026  0.110  0.168  0.199   0.251
4             sd  0.062    0.060  0.060  3168.0  0.055  0.014  0.018  0.042  0.062   0.096
5         median  0.201    0.191  0.191  3168.0  0.189  0.032  0.081  0.173  0.211   0.261
6            Q25  0.182    0.149  0.149  3168.0  0.152  0.036  0.068  0.122  0.182   0.232
7            Q75  0.228    0.226  0.226  3168.0  0.226  0.022  0.158  0.209  0.244   0.273
8            IQR  0.041    0.075  0.075  3168.0  0.074  0.036  0.015  0.040  0.109   0.132
9           skew  1.906    1.906  1.906  3168.0  2.068  0.636  0.692  1.662  2.428   4.125
10          kurt  6.450    6.450  6.450  3168.0  7.398  2.746  2.210  5.711  9.158  16.053
11        sp.ent  0.918    0.903  0.903  3168.0  0.896  0.045  0.739  0.863  0.929   0.982
12           sfm  0.085    0.396  0.396  3168.0  0.408  0.178  0.037  0.258  0.534   0.843
13          mode  0.202    0.196  0.196  3168.0  0.176  0.067  0.000  0.148  0.219   0.280
14       meanfun  0.116    0.140  0.140  3168.0  0.143  0.032  0.070  0.117  0.170   0.217
15        minfun  0.047    0.043  0.043  3168.0  0.036  0.016  0.010  0.018  0.048   0.092
16        maxfun  0.274    0.275  0.275  3168.0  0.276  0.002  0.270  0.274  0.277   0.279
17       meandom  0.008    0.760  0.760  3168.0  0.823  0.517  0.008  0.420  1.168   2.592
18        mindom  0.023    0.023  0.023  3168.0  0.041  0.056  0.005  0.008  0.023   0.281
19        maxdom  0.008    4.953  4.953  3168.0  4.922  3.263  0.008  2.070  6.984  17.344
20       dfrange  0.000    4.922  4.922  3168.0  4.870  3.262  0.000  2.045  6.906  17.320
21       modindx  0.134    0.126  0.126  3168.0  0.124  0.023  0.061  0.112  0.135   0.185

    Amplitude  Variancia  Coef_Var_%  Intervalo_Interquartil
0       0.141  6.543e-04      13.880                   0.031
1       0.141  6.543e-04      13.880                   0.031
2       0.141  6.543e-04      13.880                   0.031
3       0.141  6.543e-04      13.880                   0.031
4       0.078  1.945e-04      25.437                   0.020
5       0.181  9.928e-04      16.692                   0.038
6       0.164  1.311e-03      23.842                   0.060
7       0.116  4.645e-04       9.549                   0.034
8       0.117  1.326e-03      49.023                   0.069
```

```
9       3.433  4.039e-01      30.728                    0.766
10     13.843  7.542e+00      37.122                    3.447
11      0.243  1.991e-03       4.981                    0.066
12      0.806  3.151e-02      43.487                    0.276
13      0.280  4.442e-03      37.779                    0.071
14      0.147  1.007e-03      22.223                    0.053
15      0.082  2.529e-04      44.544                    0.030
16      0.009  5.125e-06       0.822                    0.004
17      2.584  2.672e-01      62.801                    0.748
18      0.276  3.154e-03     137.557                    0.016
19     17.336  1.065e+01      66.290                    4.914
20     17.320  1.064e+01      66.985                    4.861
21      0.124  5.403e-04      18.771                    0.024
```

Out[74]:

	quantitativas	moda	mediana	50%	count	mean	std	min	25%	75%	max	Amplitude	Varianc
0	meanfreq	0.195	0.186	0.186	3168.0	0.184	0.026	0.110	0.168	0.199	0.251	0.141	6.543e-
1	meanfreq	0.195	0.186	0.186	3168.0	0.184	0.026	0.110	0.168	0.199	0.251	0.141	6.543e-
2	centroid	0.195	0.186	0.186	3168.0	0.184	0.026	0.110	0.168	0.199	0.251	0.141	6.543e-
3	centroid	0.195	0.186	0.186	3168.0	0.184	0.026	0.110	0.168	0.199	0.251	0.141	6.543e-
4	sd	0.062	0.060	0.060	3168.0	0.055	0.014	0.018	0.042	0.062	0.096	0.078	1.945e-
5	median	0.201	0.191	0.191	3168.0	0.189	0.032	0.081	0.173	0.211	0.261	0.181	9.928e-
6	Q25	0.182	0.149	0.149	3168.0	0.152	0.036	0.068	0.122	0.182	0.232	0.164	1.311e-
7	Q75	0.228	0.226	0.226	3168.0	0.226	0.022	0.158	0.209	0.244	0.273	0.116	4.645e-
8	IQR	0.041	0.075	0.075	3168.0	0.074	0.036	0.015	0.040	0.109	0.132	0.117	1.326e-
9	skew	1.906	1.906	1.906	3168.0	2.068	0.636	0.692	1.662	2.428	4.125	3.433	4.039e-
10	kurt	6.450	6.450	6.450	3168.0	7.398	2.746	2.210	5.711	9.158	16.053	13.843	7.542e+
11	sp.ent	0.918	0.903	0.903	3168.0	0.896	0.045	0.739	0.863	0.929	0.982	0.243	1.991e-
12	sfm	0.085	0.396	0.396	3168.0	0.408	0.178	0.037	0.258	0.534	0.843	0.806	3.151e-
13	mode	0.202	0.196	0.196	3168.0	0.176	0.067	0.000	0.148	0.219	0.280	0.280	4.442e-
14	meanfun	0.116	0.140	0.140	3168.0	0.143	0.032	0.070	0.117	0.170	0.217	0.147	1.007e-
15	minfun	0.047	0.043	0.043	3168.0	0.036	0.016	0.010	0.018	0.048	0.092	0.082	2.529e-
16	maxfun	0.274	0.275	0.275	3168.0	0.276	0.002	0.270	0.274	0.277	0.279	0.009	5.125e-
17	meandom	0.008	0.760	0.760	3168.0	0.823	0.517	0.008	0.420	1.168	2.592	2.584	2.672e-
18	mindom	0.023	0.023	0.023	3168.0	0.041	0.056	0.005	0.008	0.023	0.281	0.276	3.154e-
19	maxdom	0.008	4.953	4.953	3168.0	4.922	3.263	0.008	2.070	6.984	17.344	17.336	1.065e+
20	dfrange	0.000	4.922	4.922	3168.0	4.870	3.262	0.000	2.045	6.906	17.320	17.320	1.064e+
21	modindx	0.134	0.126	0.126	3168.0	0.124	0.023	0.061	0.112	0.135	0.185	0.124	5.403e-

ORGANIZAÇÃO E APRESENTAÇÃO DOS DADOS

Tabela de frequência: relaciona categorias (ou classes) de valores, juntamente a com contagem (ou frequências) do número de valores se enquadram em cada categoria ou classe.

Variáveis qualitativas:

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

Tamanho do dataset.

In [75]:
```
print(dataset.shape)
```

```
(3168, 21)
```

Agrupar pela variável label.

In [76]:
```
contagem = dataset.groupby('label').size()
print(contagem)
```

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

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

In [77]:
```

total=3168
freqFRsexodic={}
freqFRsexodic['female']=   contagem[['female']][0] / total
freqFRsexodic['male']=    contagem[['male']][0] / total
freqFRsexodic['Total']=   (  contagem[['female']][0] / total ) + (  contagem[['male']][0] / t
```

In [78]:
```
freqFRsexodic
```

Out[78]:
```
{'female': 0.5, 'male': 0.5, 'Total': 1.0}
```

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

In [79]:
```
freqFRpcsexodic={}
freqFRpcsexodic['female']=   freqFRsexodic['female'] * 100
freqFRpcsexodic['male']=    freqFRsexodic['male']  * 100
freqFRpcsexodic['Total']=  freqFRsexodic['Total']  * 100
```

In [80]:
```
freqsexodic={}
freqsexodic['female']=contagem[['female']][0]
freqsexodic['male']=contagem[['male']][0]
freqsexodic['Total']=total
```

Montado o dataframe com os resultados.

In [81]:
```
dffrequenciaSexo = pandas.DataFrame.from_dict(freqsexodic, orient="index").reset_index()
dffrequenciaSexo.columns = ["qualitivas","contagem"]
```

In [82]:
```
dffrequenciaSexoFR = pandas.DataFrame.from_dict(freqFRsexodic, orient="index").reset_index()
dffrequenciaSexoFR.columns = ["qualitivas","freqRelativa"]
```

In [83]:
```
dffrequenciaSexoFRpc = pandas.DataFrame.from_dict(freqFRpcsexodic, orient="index").reset_inde
dffrequenciaSexoFRpc.columns = ["qualitivas","freqRelativa%"]
```

In [84]:
```
dftabelaFreqQualitativas=pandas.merge(dffrequenciaSexo,dffrequenciaSexoFR,how='right',on='qua
dftabelaFreqQualitativas=pandas.merge(dftabelaFreqQualitativas,dffrequenciaSexoFRpc,how='righ
```

In [85]:
```
dftabelaFreqQualitativas
```

Out[85]:

	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 [86]:
```
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
```

Comparativo dos dados.

In [87]:

```
# 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 [88]:

```
# Carrega os dados limpos
url = ".\\baseDados\\voice_fix.csv"
colunas = ["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","sfm","mode","ce
dataset = pandas.read_csv(url, names=colunas, sep = ",")
```

In [89]:

```
dataset.head()
```

Out[89]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt	sp.ent	sfm	...	centroid	meanfun	minfun	ma
0	0.173	0.064	0.177	0.121	0.228	0.109	1.906	6.450	0.893	0.492	...	0.173	0.084	0.016	0
1	0.173	0.067	0.177	0.121	0.228	0.109	1.906	6.450	0.892	0.514	...	0.173	0.108	0.016	0
2	0.173	0.064	0.177	0.121	0.228	0.123	1.906	6.450	0.919	0.479	...	0.173	0.099	0.016	0
3	0.151	0.061	0.158	0.097	0.208	0.111	1.233	4.177	0.963	0.727	...	0.151	0.089	0.018	0
4	0.135	0.063	0.125	0.079	0.206	0.127	1.101	4.334	0.972	0.784	...	0.135	0.106	0.017	0

5 rows × 21 columns

In [90]:

```

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

In [91]:

```
dfHomens.head()
```

Out[91]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt	sp.ent	sfm	...	centroid	meanfun	minfun	ma
0	0.173	0.064	0.177	0.121	0.228	0.109	1.906	6.450	0.893	0.492	...	0.173	0.084	0.016	0
1	0.173	0.067	0.177	0.121	0.228	0.109	1.906	6.450	0.892	0.514	...	0.173	0.108	0.016	0
2	0.173	0.064	0.177	0.121	0.228	0.123	1.906	6.450	0.919	0.479	...	0.173	0.099	0.016	0
3	0.151	0.061	0.158	0.097	0.208	0.111	1.233	4.177	0.963	0.727	...	0.151	0.089	0.018	0
4	0.135	0.063	0.125	0.079	0.206	0.127	1.101	4.334	0.972	0.784	...	0.135	0.106	0.017	0

5 rows × 21 columns

In [92]:

```
dfMuheres.head()
```

Out[92]:

	meanfreq	sd	median	Q25	Q75	IQR	skew	kurt	sp.ent	sfm	...	centroid	meanfun	minfun
1584	0.158	0.083	0.191	0.182	0.225	0.041	2.801	9.346	0.952	0.679	...	0.158	0.185	0.023
1585	0.183	0.068	0.201	0.175	0.226	0.051	3.002	9.346	0.910	0.506	...	0.183	0.160	0.019
1586	0.200	0.062	0.211	0.184	0.236	0.051	2.544	14.922	0.904	0.425	...	0.200	0.156	0.016
1587	0.195	0.072	0.205	0.181	0.256	0.040	2.392	10.061	0.907	0.524	...	0.195	0.183	0.025
1588	0.209	0.058	0.220	0.190	0.250	0.059	1.708	5.671	0.880	0.344	...	0.209	0.162	0.017

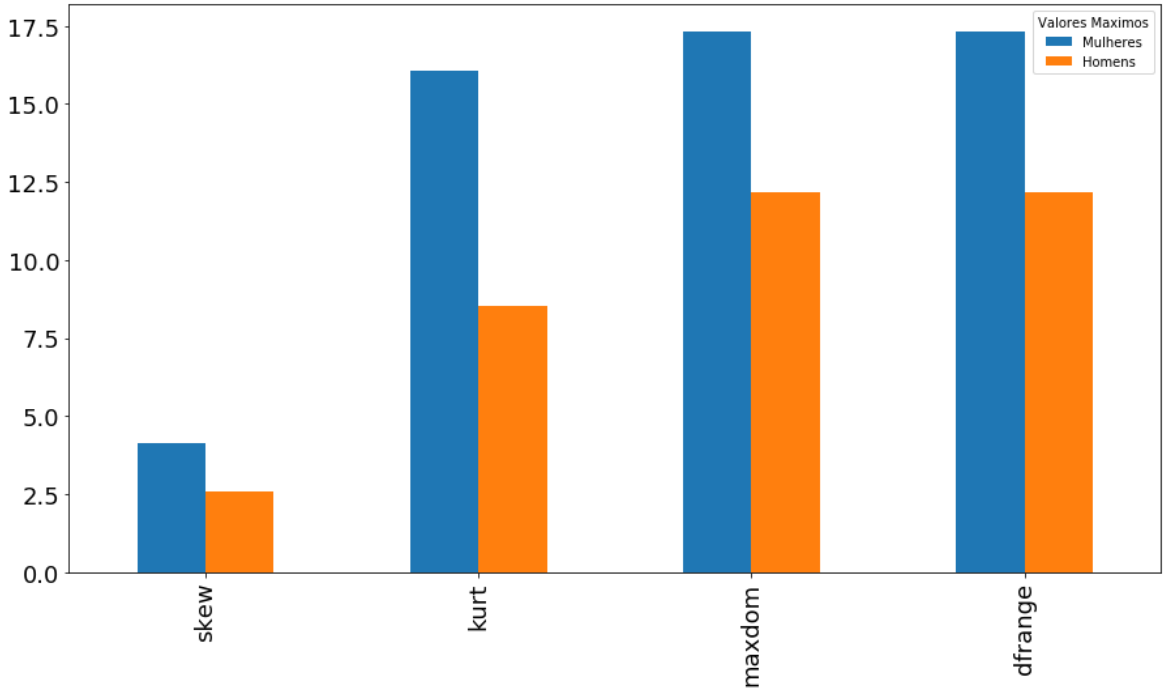
5 rows × 21 columns

Gráfico comparativo com valores máximos.

In [93]:

```
DadosMax = []
for x in colunas:
    if x in ["label"]:
        continue
    if x in ["label","meanfreq","sd","median","Q25","Q75","IQR"]:
        continue
    if x in ["sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meandom","mindom",
        continue
   # if x in ["skew","kurt","maxdom","dfrange"]:
   #     continue


    Linha =[]
    Linha.append(dfMuheres[x].max())
    Linha.append(dfHomens[x].max())
    DadosMax.append(Linha)

df = pd.DataFrame(DadosMax,
                  index=["skew","kurt","maxdom","dfrange"],
                  columns=pd.Index(['Mulheres', 'Homens'],
                 name='Valores Maximos')).round(2)


df.plot(kind='bar',figsize=(15,8),fontsize=18)
```

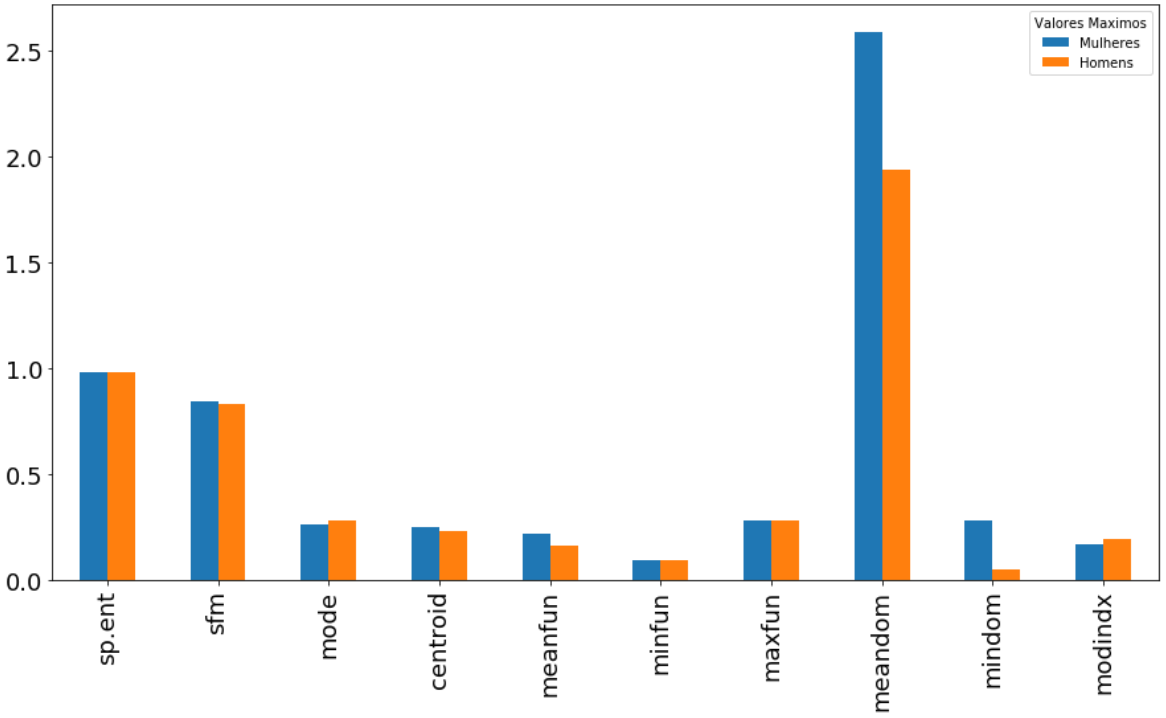
Out[93]: <matplotlib.axes._subplots.AxesSubplot at 0x5c52d70>



In [94]:

```
DadosMax = []
for x in colunas:
    if x in ["label"]:
        continue
    if x in ["label","meanfreq","sd","median","Q25","Q75","IQR"]:
        continue
   # if x in ["sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meandom","mindom"
    #    continue
    if x in ["skew","kurt","maxdom","dfrange"]:
        continue


    Linha =[]
    Linha.append(dfMuheres[x].max())
    Linha.append(dfHomens[x].max())
    DadosMax.append(Linha)

df = pd.DataFrame(DadosMax,
                  index=["sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meando
                  columns=pd.Index(['Mulheres', 'Homens'],
                 name='Valores Maximos')).round(2)


df.plot(kind='bar',figsize=(15,8),fontsize=18)
```

Out[94]: <matplotlib.axes._subplots.AxesSubplot at 0x5c99fd0>

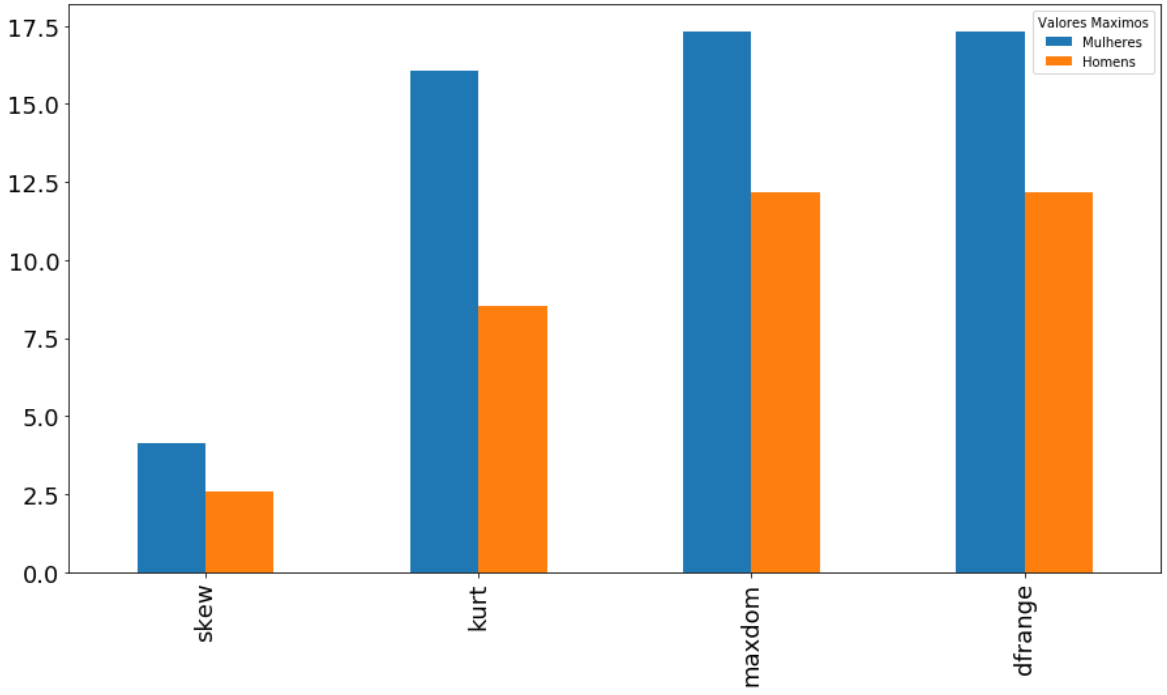


In [95]:

```
DadosMax = []
for x in colunas:
    if x in ["label"]:
        continue
    if x in ["label","meanfreq","sd","median","Q25","Q75","IQR"]:
        continue
    if x in ["sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meandom","mindom",
        continue
    #if x in ["skew","kurt","maxdom","dfrange"]:
     #   continue


    Linha =[]
    Linha.append(dfMuheres[x].max())
    Linha.append(dfHomens[x].max())
    DadosMax.append(Linha)

df = pd.DataFrame(DadosMax,
                  index=["skew","kurt","maxdom","dfrange"],
                  columns=pd.Index(['Mulheres', 'Homens'],
                 name='Valores Maximos')).round(2)


df.plot(kind='bar',figsize=(15,8),fontsize=18)
```

Out[95]:

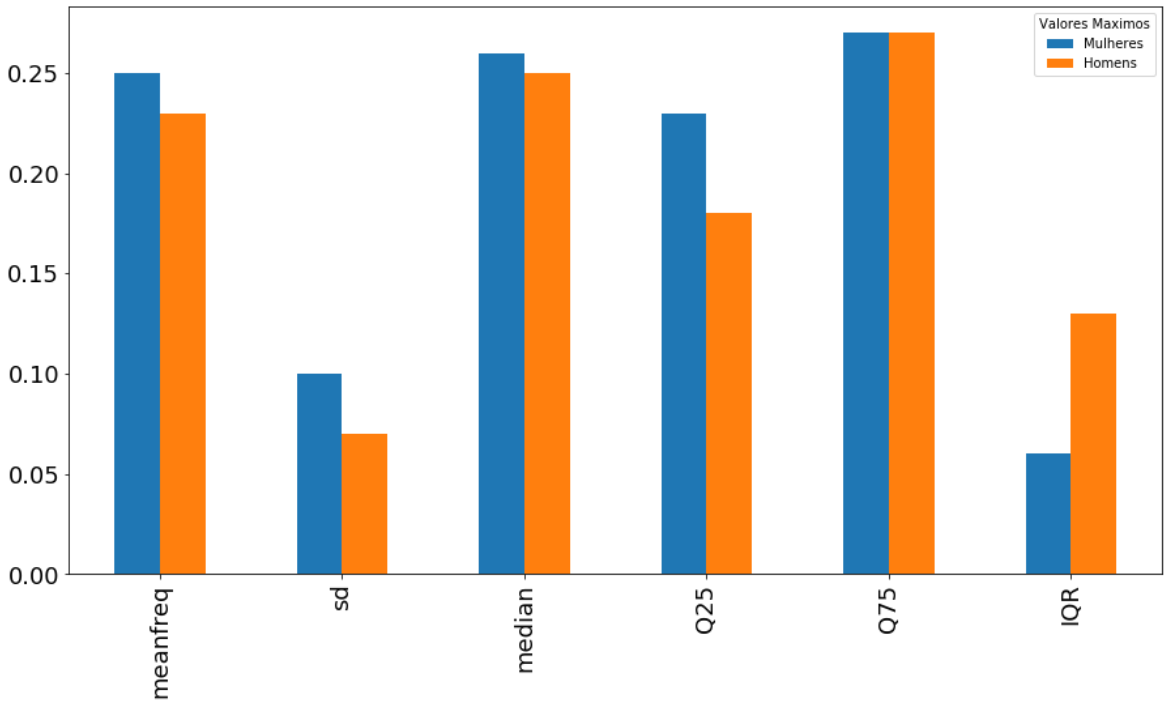
```
<matplotlib.axes._subplots.AxesSubplot at 0x13aeb070>
```



In [96]:

```
DadosMax = []
for x in colunas:
    if x in ["label"]:
        continue
    #if x in ["meanfreq","sd","median","Q25","Q75","IQR"]:
   #     continue
    if x in ["sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meandom","mindom",
        continue
    if x in ["skew","kurt","maxdom","dfrange"]:
        continue


    Linha =[]
    Linha.append(dfMuheres[x].max())
    Linha.append(dfHomens[x].max())
    DadosMax.append(Linha)

df = pd.DataFrame(DadosMax,
                  index=["meanfreq","sd","median","Q25","Q75","IQR"],
                  columns=pd.Index(['Mulheres', 'Homens'],
                 name='Valores Maximos')).round(2)


df.plot(kind='bar',figsize=(15,8),fontsize=18)
```

Out[96]: <matplotlib.axes._subplots.AxesSubplot at 0x12019190>



In [97]:

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



    if x in ["label"]:
        continue
   # if x in ["IQR","median","Q25","Q75","meanfreq","sd"]:
   #     continue
    if x in ["dfrange","sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meandom"
        continue
    if x in ["skew","kurt"]:
        continue



    Linha =[]
    Linha.append(dfMuheres[x].min())
    Linha.append(dfHomens[x].min())
    DadosMin.append(Linha)



df = pd.DataFrame(DadosMin,
                  index=["IQR","median","Q25","Q75","meanfreq","sd"],
                  columns=pd.Index(['Mulheres', 'Homens'],
                 name='Valores Mínimos')).round(2)


df.plot(kind='bar',figsize=(15,8),fontsize=18)
```

Out[97]: <matplotlib.axes._subplots.AxesSubplot at 0x13a97c10>

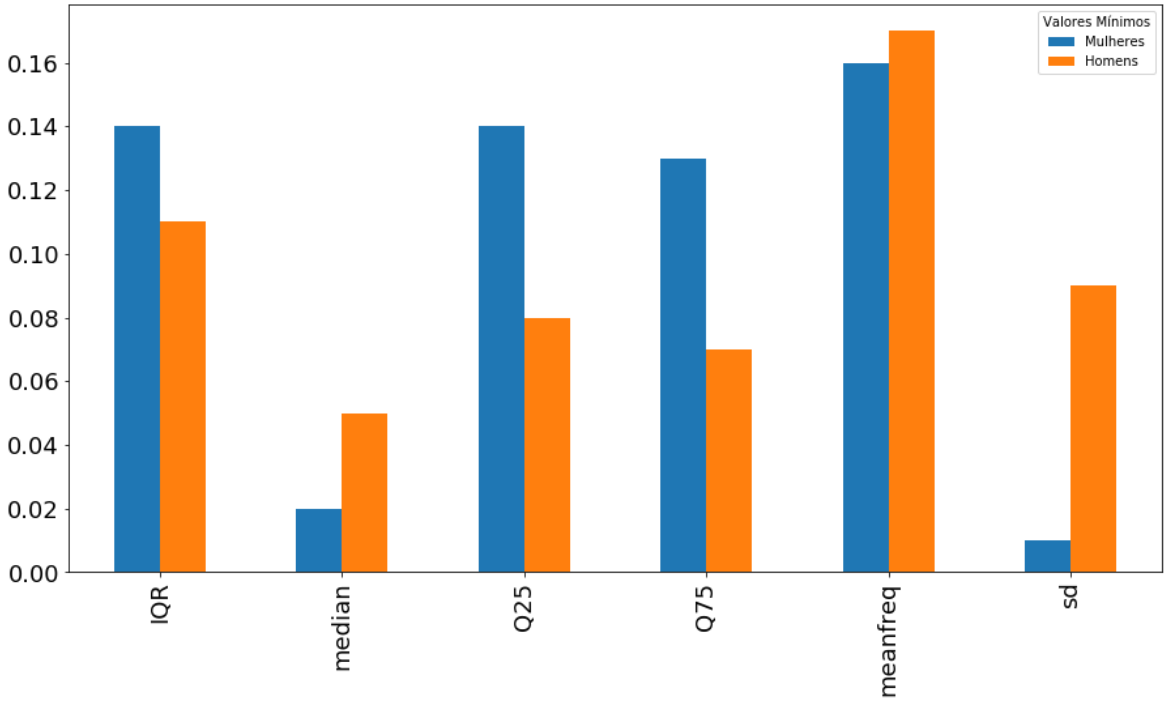
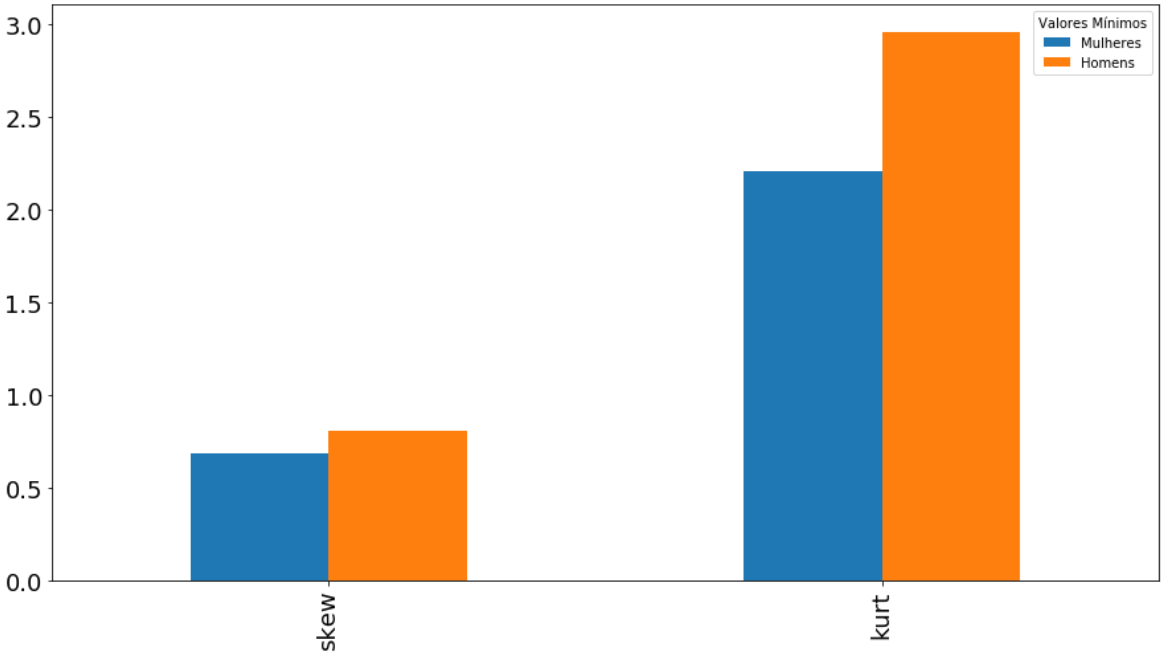


Gráfico comparativo com valores mínimos.

In [98]:

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



    if x in ["label"]:
        continue
    if x in ["IQR","median","Q25","Q75","meanfreq","sd"]:
        continue
    if x in ["dfrange","sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meandom"
        continue
   # if x in ["skew","kurt","maxdom","dfrange"]:
       # continue



    Linha =[]
    Linha.append(dfMuheres[x].min())
    Linha.append(dfHomens[x].min())
    DadosMin.append(Linha)



df = pd.DataFrame(DadosMin,
                  index=["skew","kurt"],
                  columns=pd.Index(['Mulheres', 'Homens'],
                 name='Valores Mínimos')).round(2)


df.plot(kind='bar',figsize=(15,8),fontsize=18)
```

Out[98]: <matplotlib.axes._subplots.AxesSubplot at 0x135f1930>



In [99]:

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



    if x in ["label"]:
        continue
    if x in ["IQR","median","Q25","Q75","meanfreq","sd"]:
        continue
   # if x in ["dfrange","sp.ent","sfm","mode","centroid","meanfun","minfun","maxfun","meandom
    #    continue
    if x in ["skew","kurt","maxfun","meandom","mindom","modindx"]:
        continue



    Linha =[]
    Linha.append(dfMuheres[x].min())
    Linha.append(dfHomens[x].min())
    DadosMin.append(Linha)



df = pd.DataFrame(DadosMin,
                  index=["dfrange","sp.ent","sfm","mode","centroid","meanfun","minfun","maxdo
                  columns=pd.Index(['Mulheres', 'Homens'],
                 name='Valores Mínimos')).round(2)


df.plot(kind='bar',figsize=(15,8),fontsize=18)
```

Out[99]: <matplotlib.axes._subplots.AxesSubplot at 0x13783370>

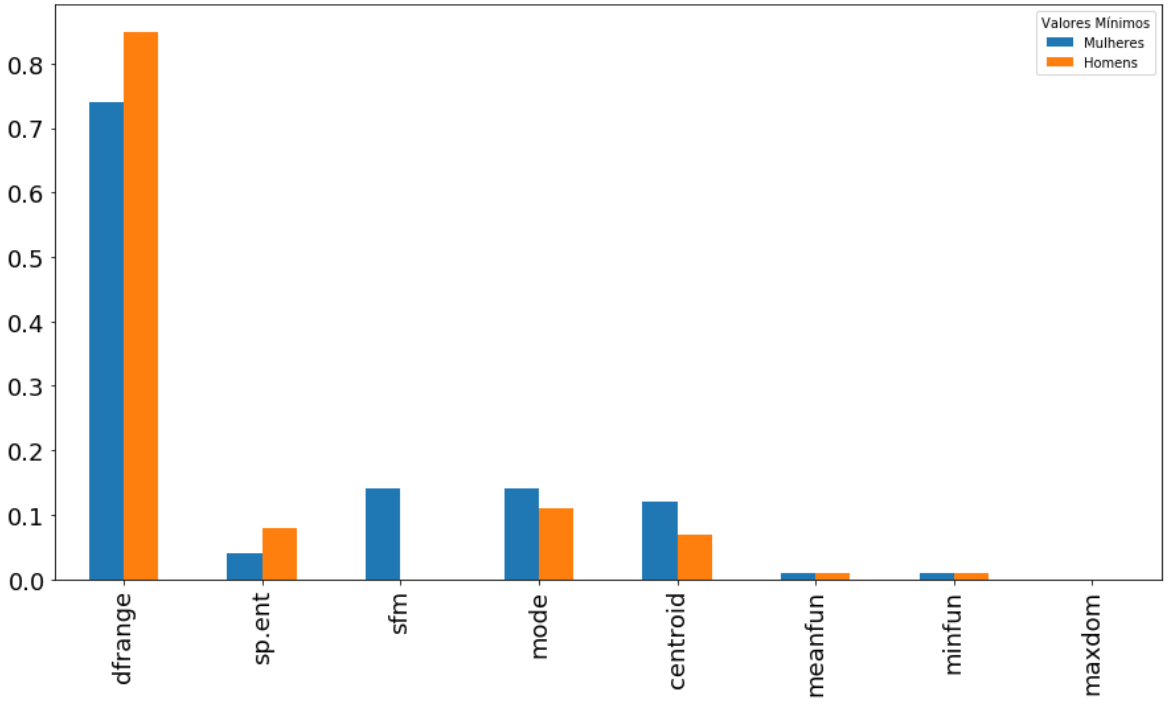


Gráfico comparativo com valores média.

In [100]:

```
DadosMedia = []
for x in colunas:
    if x == "label":
        continue
    if x in ["meanfreq","sd","median","Q25","Q75","IQR","mode","centroid","meanfun","minfun",
        continue

    Linha =[]

    Linha.append(dfMuheres[x].mean())
    Linha.append(dfHomens[x].mean())
    DadosMedia.append(Linha)
```

In [101]:

```
df = pd.DataFrame(DadosMedia,
                  index=["skew","kurt","sp.ent","sfm","meandom","mindom","maxdom","dfrange","
                  columns=pd.Index(['Mulheres', 'Homens'],
                 name='Média')).round(2)


df.plot(kind='bar',figsize=(15,8),fontsize=18)
```

Out[101]: <matplotlib.axes._subplots.AxesSubplot at 0x1378d210>

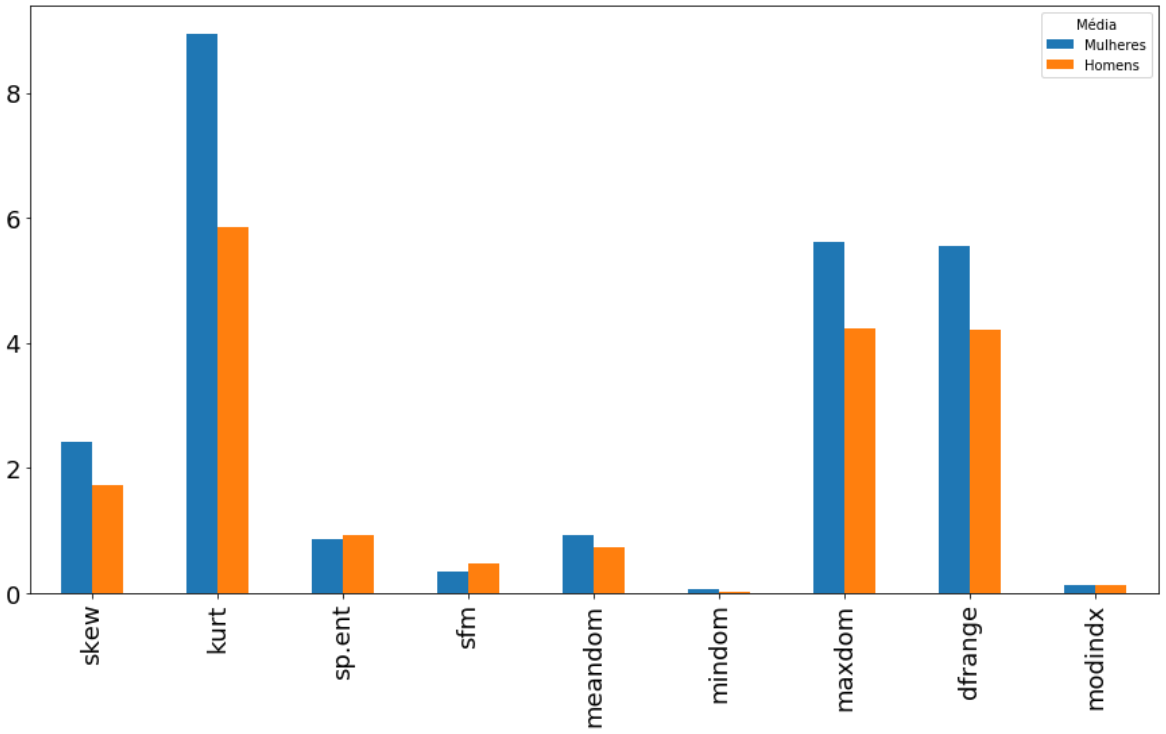


Gráfico comparativo com valores mediana.

In [102]:

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

In [103]:

```
df = pd.DataFrame(DadosMediana,
                  index=["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","s
                  columns=pd.Index(['Mulheres', 'Homens'],
                 name='Mediana')).round(2)


df.plot(kind='bar',figsize=(15,8),fontsize=18)
```

Out[103]: <matplotlib.axes._subplots.AxesSubplot at 0x13843290>

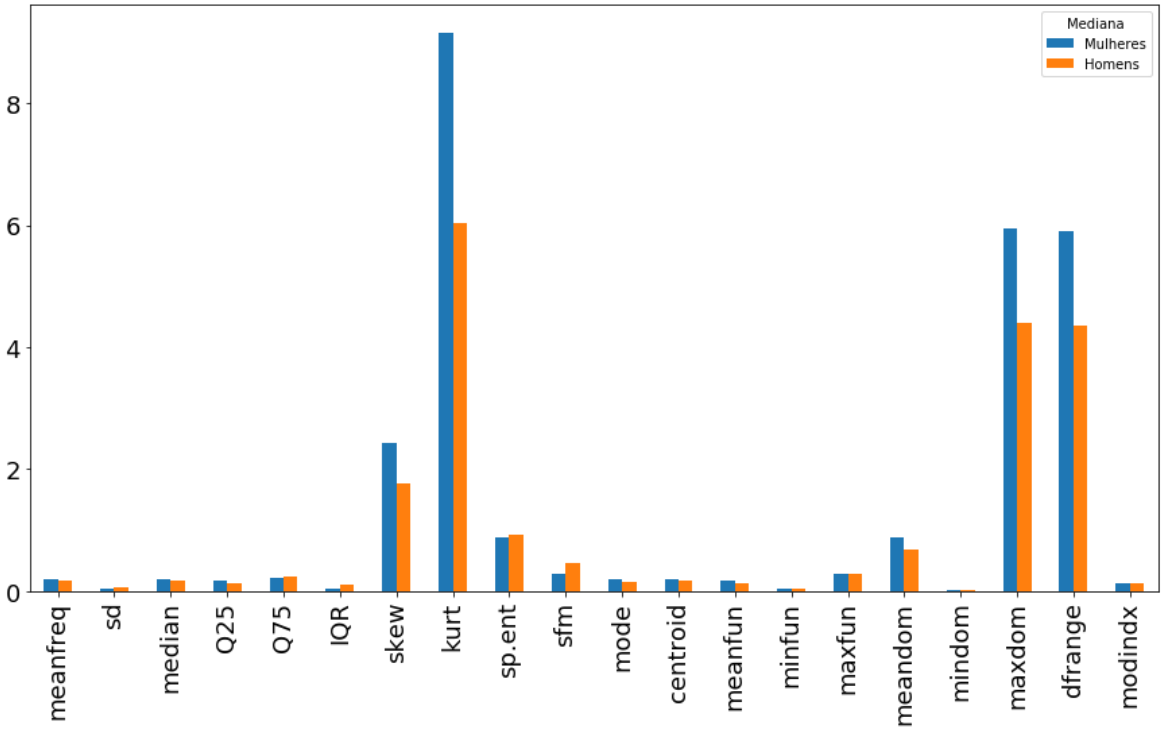


Gráfico comparativo com valores Desvio padrão.

In [104]:

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

In [105]:

```
df = pd.DataFrame(Dadosdp,
                  index=["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","s
                  columns=pd.Index([ 'Mulheres', 'Homens'],
                 name='Desvio padrão')).round(2)


df.plot(kind='bar',figsize=(15,8),fontsize=18)
```

Out[105]: <matplotlib.axes._subplots.AxesSubplot at 0x5cb4770>

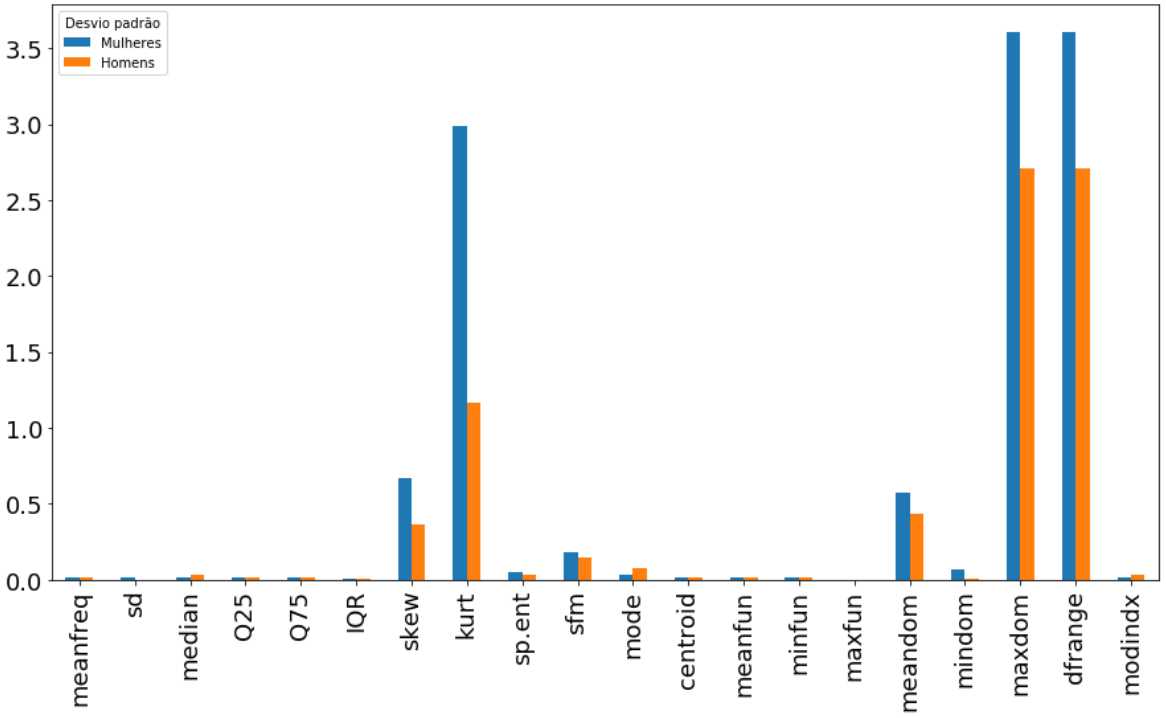


Gráfico comparativo com valores Variância.

In [106]:

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

In [107]:

```
df = pd.DataFrame(Dadosvr,
                  index=["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","s
                  columns=pd.Index([ 'Mulheres', 'Homens'],
                 name='Variância')).round(2)


df.plot(kind='bar',figsize=(15,8),fontsize=18)
```

Out[107]: <matplotlib.axes._subplots.AxesSubplot at 0x135db750>

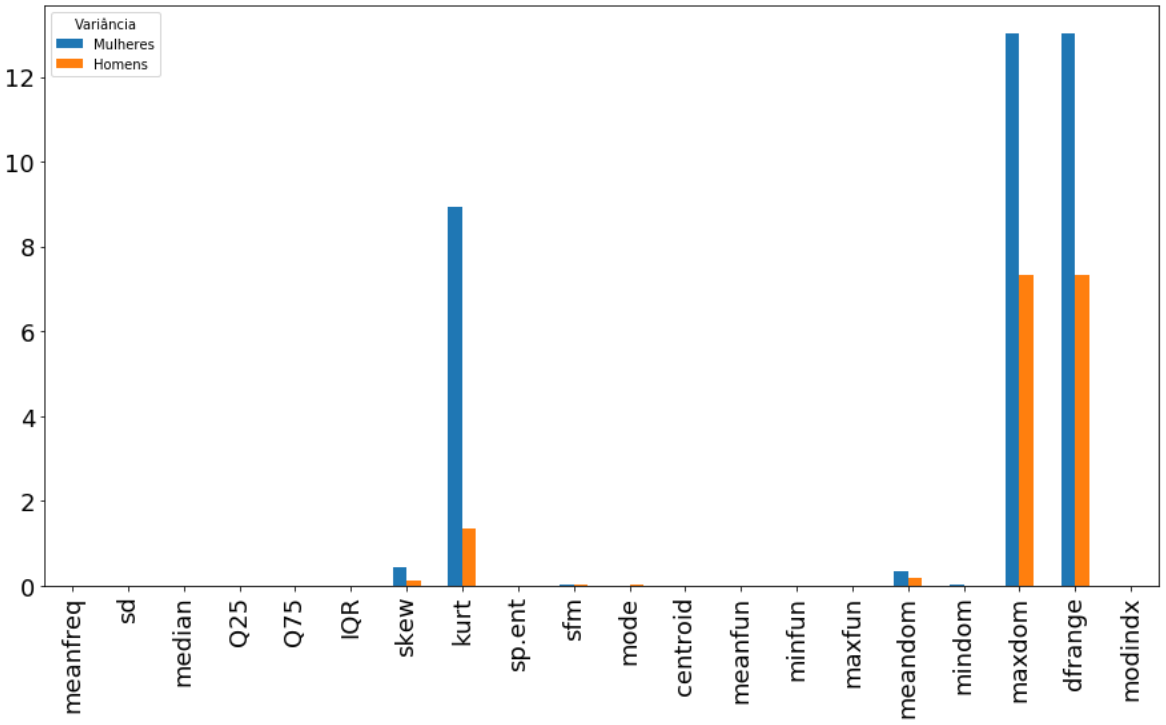


Gráfico comparativo com valores Amplitude.

In [108]:

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


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



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

In [109]:

```
df = pd.DataFrame(Dados,
                  index=["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","s
                  columns=pd.Index([ 'Mulheres', 'Homens'],
                 name='Amplitude')).round(2)


df.plot(kind='bar',figsize=(15,8),fontsize=18)
```

Out[109]: <matplotlib.axes._subplots.AxesSubplot at 0x13819bf0>

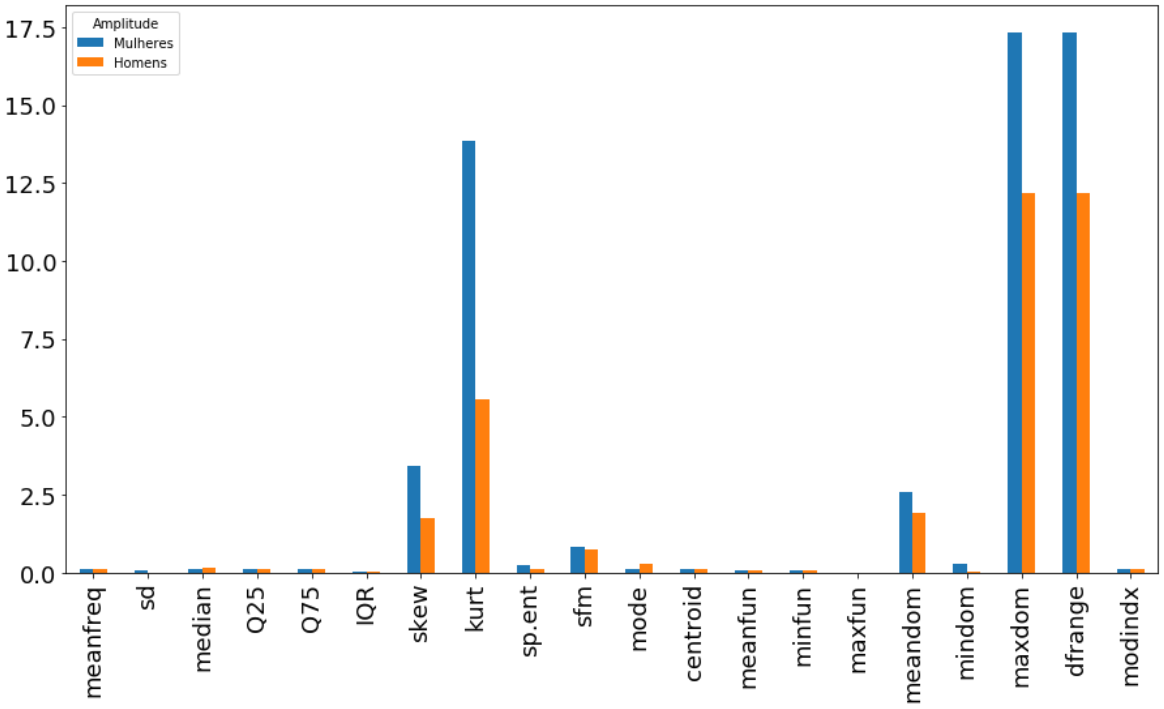


Gráfico comparativo com valores Moda.

In [110]:

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

In [111]:

```
df = pd.DataFrame(Dados,
                  index=["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","s
                  columns=pd.Index([ 'Mulheres', 'Homens'],
                 name='MODA')).round(2)


df.plot(kind='bar',figsize=(15,8),fontsize=18)
```

Out[111]: <matplotlib.axes._subplots.AxesSubplot at 0x137c5230>

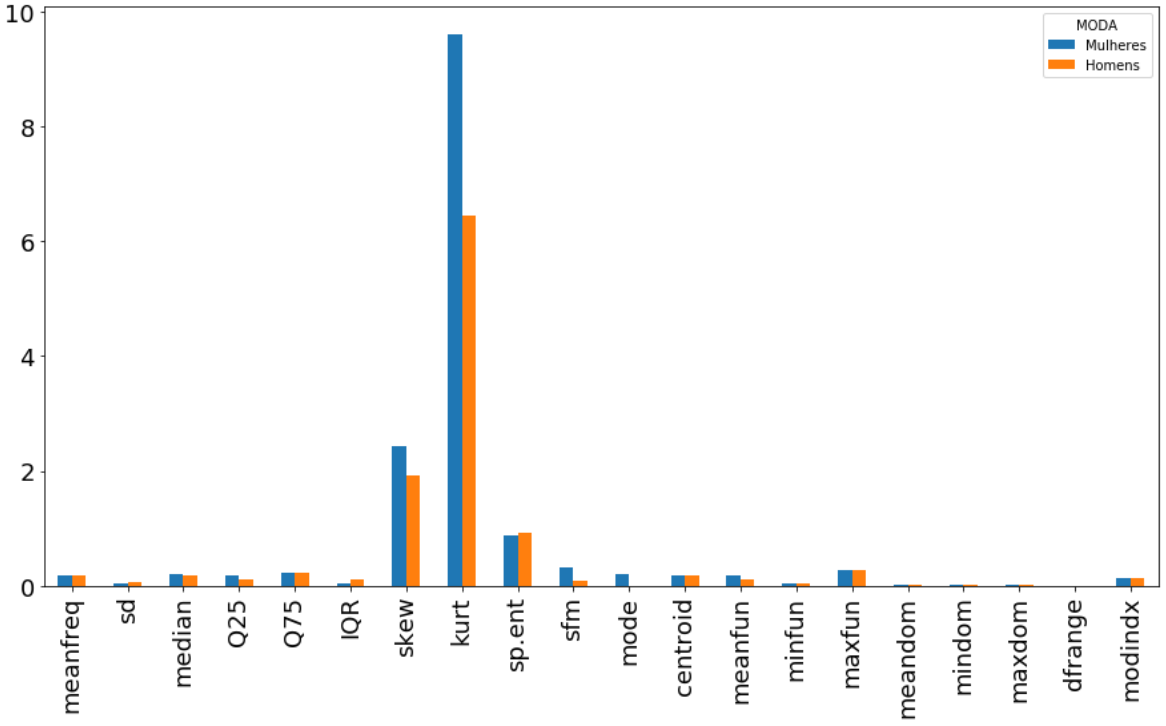


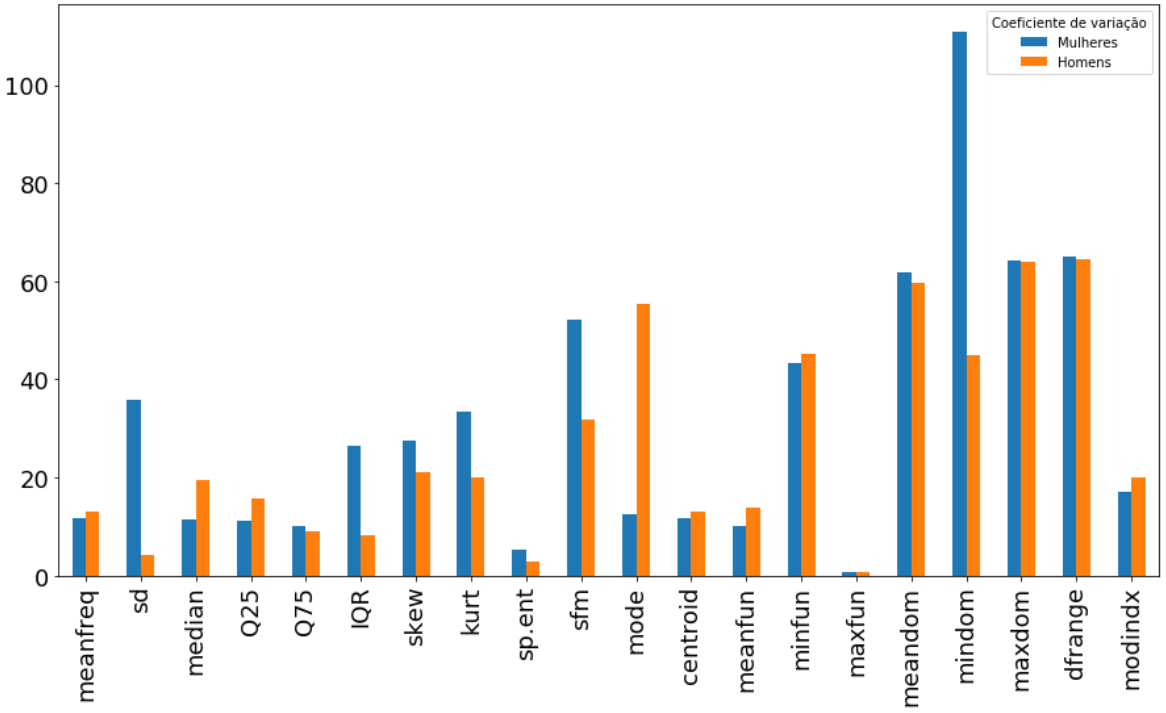
Gráfico comparativo com valores Coeficiente de variação.

In [112]:

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

In [113]:
```
df = pd.DataFrame(Dados,
                  index=["meanfreq","sd","median","Q25","Q75","IQR","skew","kurt","sp.ent","s
                  columns=pd.Index([ 'Mulheres', 'Homens'],
                 name='Coeficiente de variação')).round(2)


df.plot(kind='bar',figsize=(15,8),fontsize=18)
```

Out[113]: <matplotlib.axes._subplots.AxesSubplot at 0x13dd50f0>



In [114]:
```
sns=sb
```

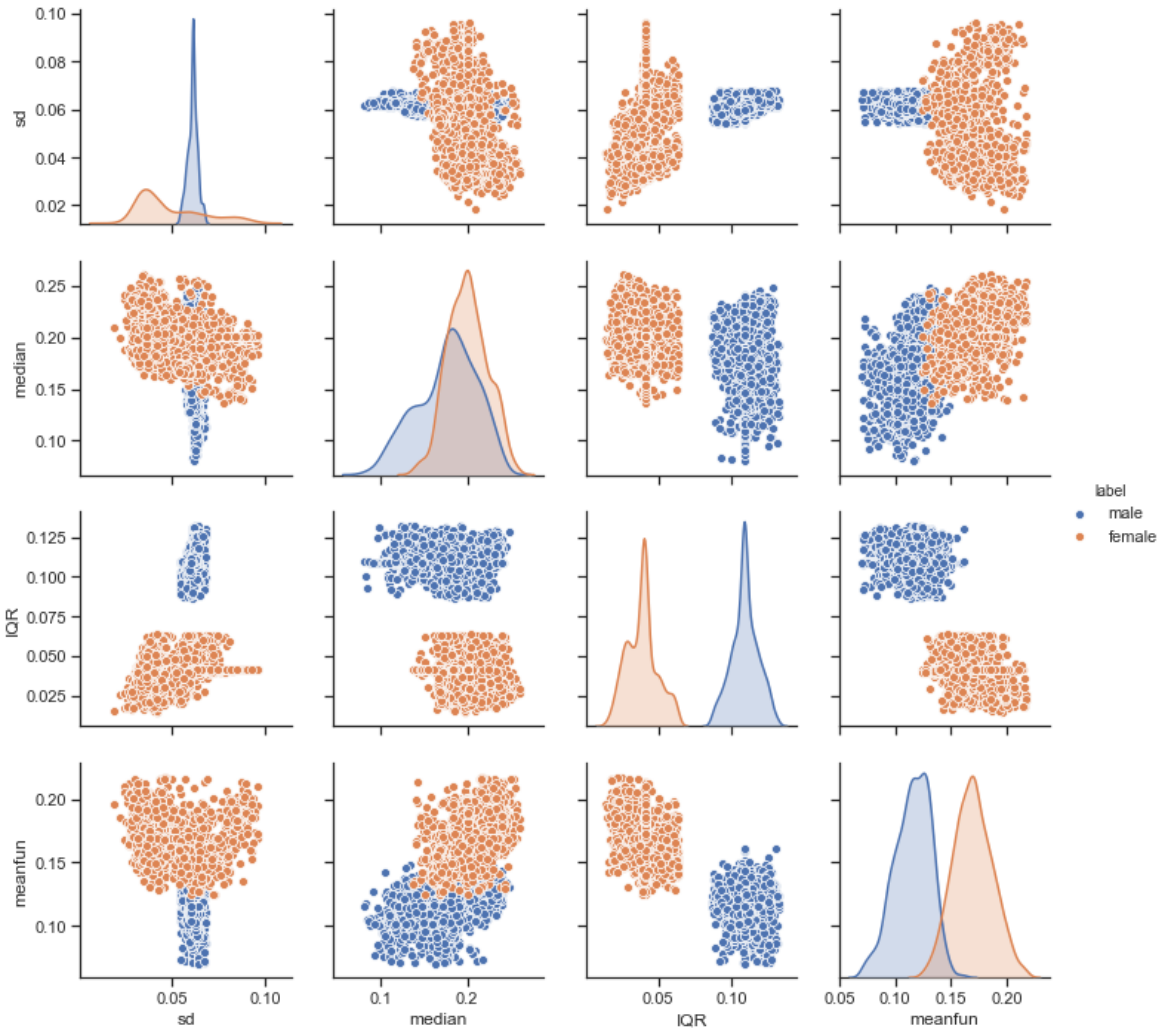
In [115]:
```
#-----------------------------------------------------------------------
#sns.set(style="ticks")
#df = dataset
#sns.pairplot(df, hue="label")
#-----------------------------------------------------------------------------
```

In [116]:
```
#-------------------------------------------------------------
#flatui = [ "#34495e", "#9b59b6", "#95a5a6", "#e74c3c","#3498db", "#2ecc71"]
#sns.palplot(sns.color_palette("Paired"))
#sns.palplot(sns.color_palette(flatui))
#g = sns.PairGrid(dataset, vars=['meanfreq', 'sd', 'median', 'meanfun'],   hue='label', palet
#g.map(plt.scatter, alpha=0.5)
#g.add_legend();
#-----------------------------------------------
```

In [117]:

```
#-----------------------------------------------------------------------
sns.set(style="ticks")
df = dataset
sns.pairplot(df, vars=['sd', 'median','IQR', 'meanfun'], hue="label")
#-------------------------------------------------------------------------
```

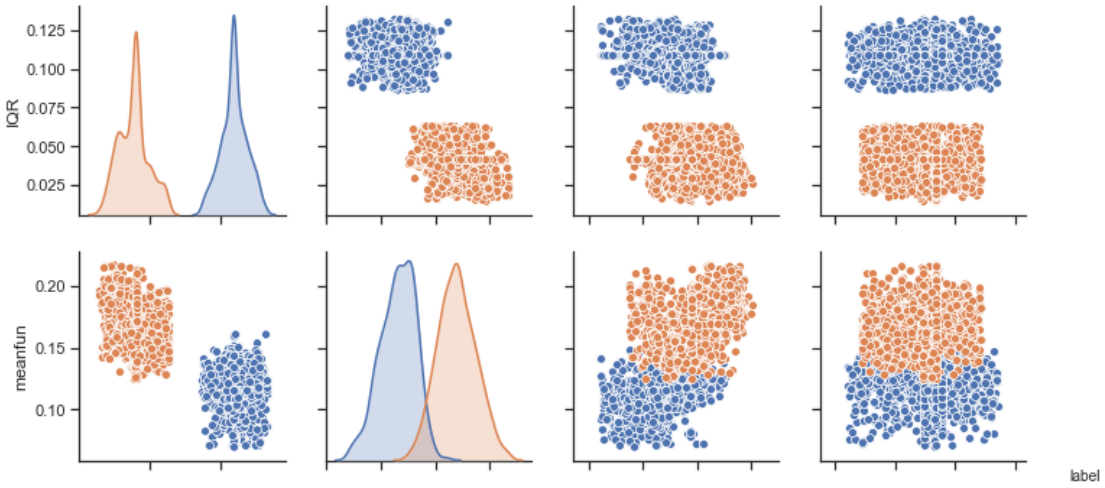
Out[117]: <seaborn.axisgrid.PairGrid at 0x140aab90>



In [118]:

```
#-----------------------------------------------------------------------
sns.set(style="ticks")
df = dataset
sns.pairplot(df, vars=['IQR', 'meanfun','centroid', 'modindx'], hue="label")
#-------------------------------------------------------------------------
```

Out[118]: <seaborn.axisgrid.PairGrid at 0x140aad70>



Fim da análise exploraria.

In [ ]: