Plotter

October 20, 2019

1 Tabla de contenido

In [ ]:

In [1]:
```
import pandas as pd
import seaborn as sns
import csv
import matplotlib.pyplot as plt
from mpl_toolkits.mplot3d import Axes3D
import numpy as np
from IPython.display import display, HTML
from matplotlib.ticker import FormatStrFormatter
```

```
/home/eric/anaconda3/envs/tesina/lib/python3.7/site-packages/matplotlib/__init__.py:886: Matplo
examples.directory is deprecated; in the future, examples will be found relative to the 'datapa
  "found relative to the 'datapath' directory.".format(key))
```

In [2]:
```
%matplotlib inline
```

In [3]:
```
dormidos=pd.read_csv('entropyPaper/Data/physionet/Sleep.csv')
despiertos=pd.read_csv('entropyPaper/Data/physionet/Wake.csv')
```

In [4]:
```
dormidosCHF=dormidos[dormidos['Class']==1]
dormidosH=dormidos[dormidos['Class']==0]
despiertosCHF=despiertos[despiertos['Class']==1]
despiertosH=despiertos[despiertos['Class']==0]
```

In [5]:
```
dormidosCHF.head()
```

Out[5]:

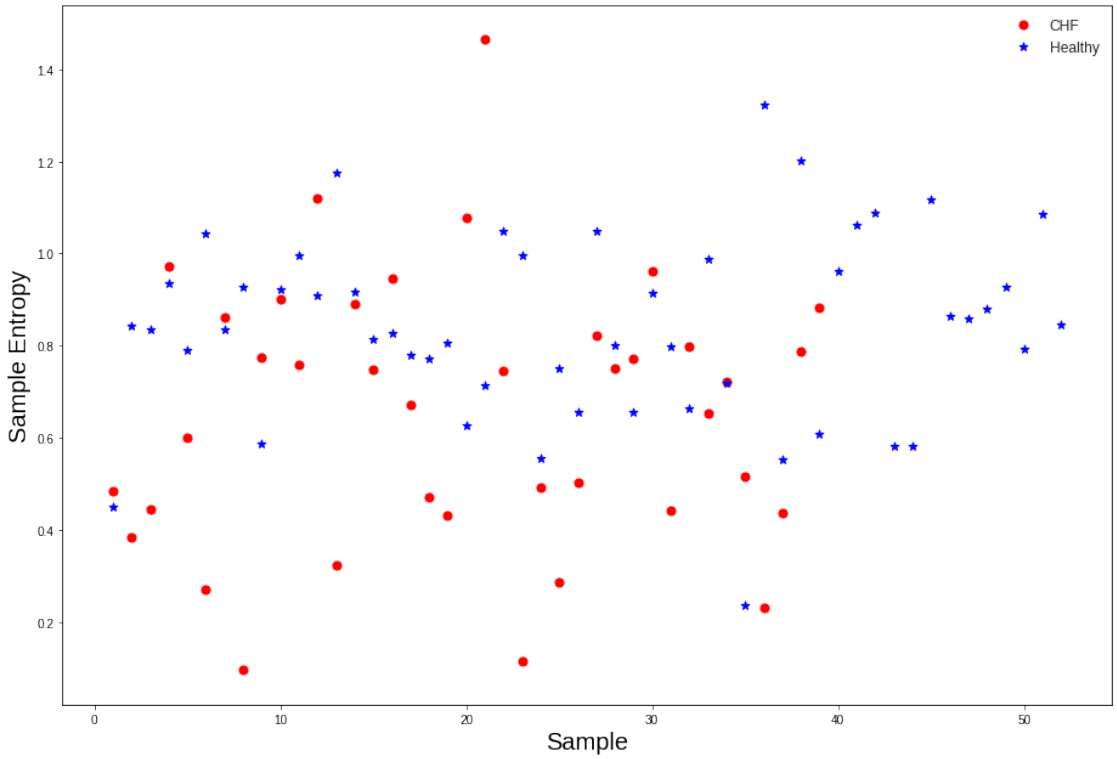
	Subject	SampleEntropy	FuzzyEntropy	ApEntropy	Class
0	chf001s.txt	0.485001	0.2652	0.6739	1
1	chf002s.txt	0.383171	0.3914	0.5777	1
2	chf004s.txt	0.445298	0.2151	0.6450	1
3	chf005s.txt	0.973072	0.3695	1.0589	1
4	chf006s.txt	0.601315	0.6085	0.9845	1

2 Gráficas de magnitud para las diferentes entropias Physionet

In [6]:
```
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])

plt.style.use('seaborn-darkgrid')
axes.scatter(np.arange(1,len(dormidosCHF)+1),dormidosCHF['SampleEntropy'],c='r',marker=
axes.scatter(np.arange(1,len(dormidosH)+1),dormidosH['SampleEntropy'],c='b',marker='*'

plt.legend(['CHF','Healthy'],fontsize=12)
plt.xlabel('Sample',fontsize=20)
plt.ylabel('Sample Entropy',fontsize=20)
plt.savefig('./images/Physionet_SE_scatter.jpg')
```

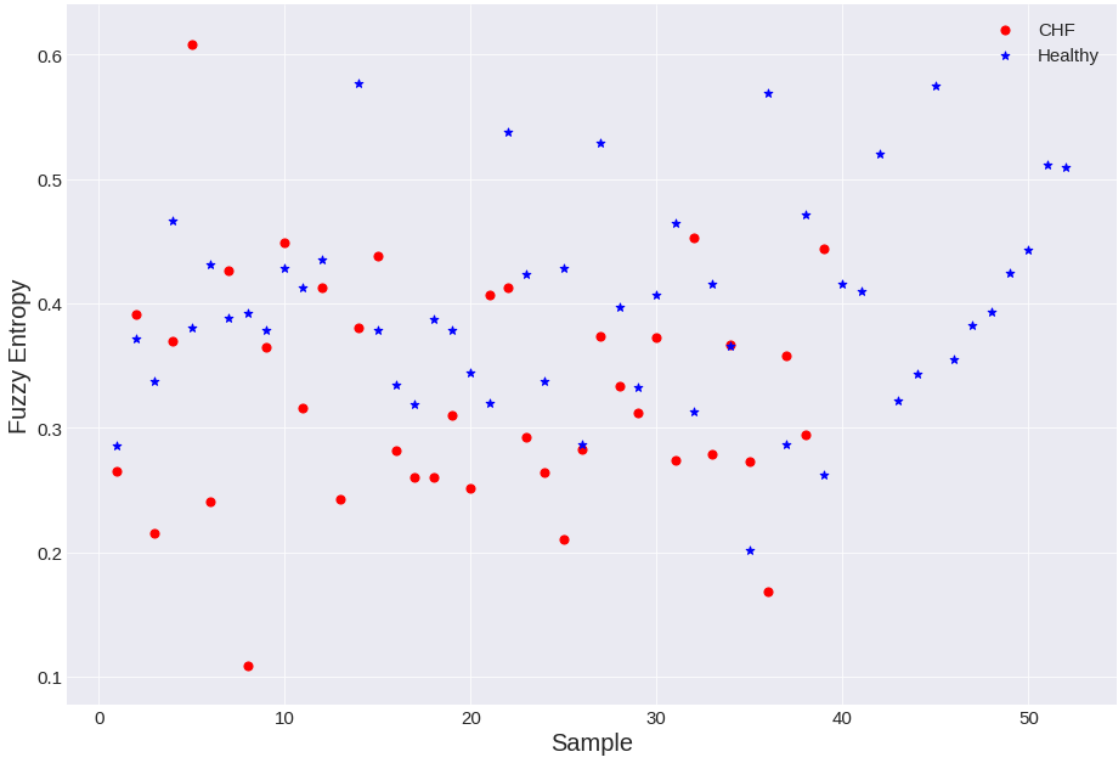


In [7]:
```
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])
```

```
plt.style.use('seaborn-darkgrid')
axes.scatter(np.arange(1,len(dormidosCHF)+1),dormidosCHF['FuzzyEntropy'],c='r',marker=
axes.scatter(np.arange(1,len(dormidosH)+1),dormidosH['FuzzyEntropy'],c='b',marker='*',

plt.legend(['CHF','Healthy'],fontsize=15)
plt.xlabel('Sample',fontsize=20)
plt.ylabel('Fuzzy Entropy',fontsize=20)
plt.xticks(fontsize=15)
plt.yticks(fontsize=15)
```

Out[7]:
```
(array([0. , 0.1, 0.2, 0.3, 0.4, 0.5, 0.6, 0.7]),
 <a list of 8 Text yticklabel objects>)
```



In [8]:
```
np.arange(1,10)
```

Out[8]:
```
array([1, 2, 3, 4, 5, 6, 7, 8, 9])
```

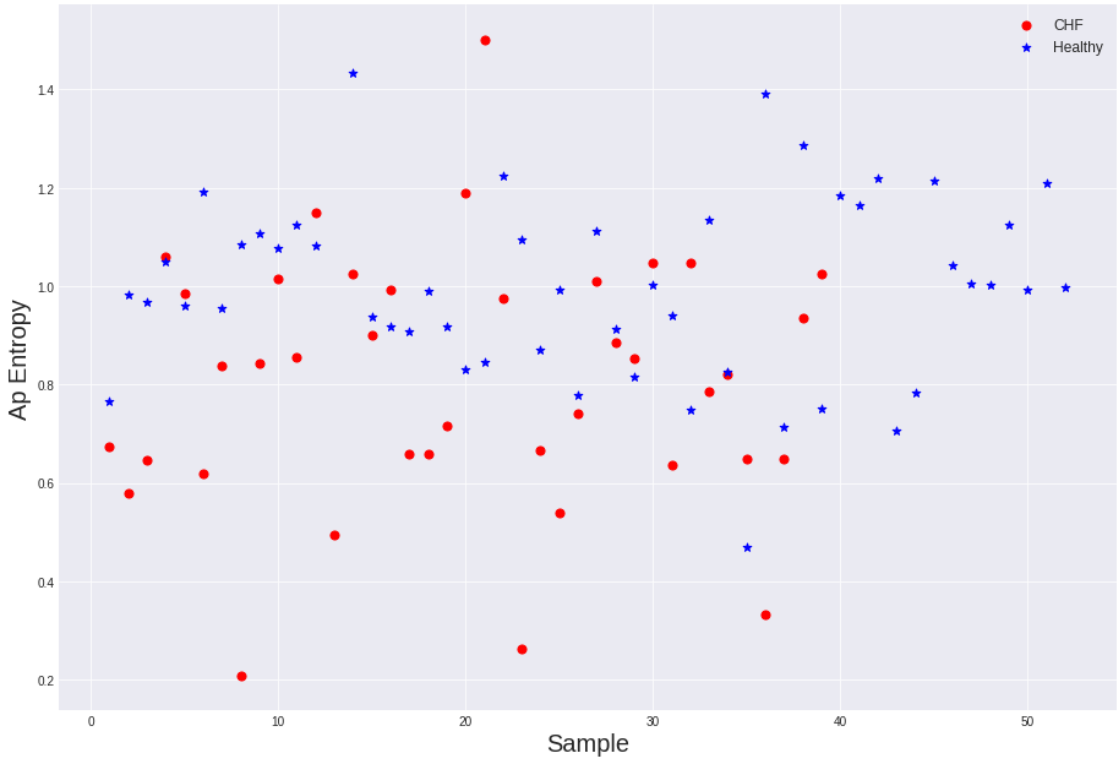
In [9]:
```
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])

plt.style.use('seaborn-darkgrid')
axes.scatter(np.arange(1,len(dormidosCHF)+1),dormidosCHF['ApEntropy'],c='r',marker='o'
```

```
axes.scatter(np.arange(1,len(dormidosH)+1),dormidosH['ApEntropy'],c='b',marker='*',s=5(

plt.legend(['CHF','Healthy'],fontsize=12)
plt.xlabel('Sample',fontsize=20)
plt.ylabel('Ap Entropy',fontsize=20)
```

Out[9]: Text(0, 0.5, 'Ap Entropy')

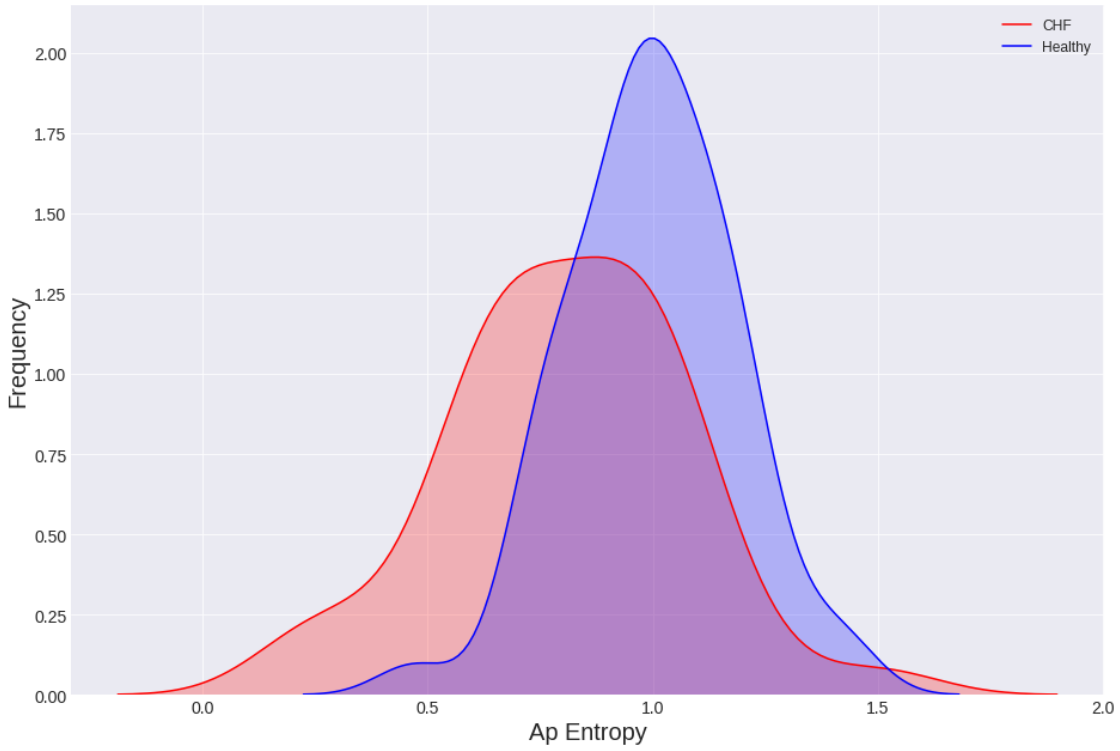


3 Graficas de frecuencia Physionet

```
In [10]: # plot of 2 variables
         fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])
         p1=sns.kdeplot(dormidosCHF['ApEntropy'], shade=True, color="r")
         p1=sns.kdeplot(dormidosH['ApEntropy'], shade=True, color="b")
         plt.legend(['CHF','Healthy'],fontsize=12)
         plt.xlabel('Ap Entropy',fontsize=20)
         plt.ylabel('Frequency',fontsize=20)
         plt.xticks(fontsize = 14)
         plt.yticks(fontsize = 14)
         #sns.plt.show()
```

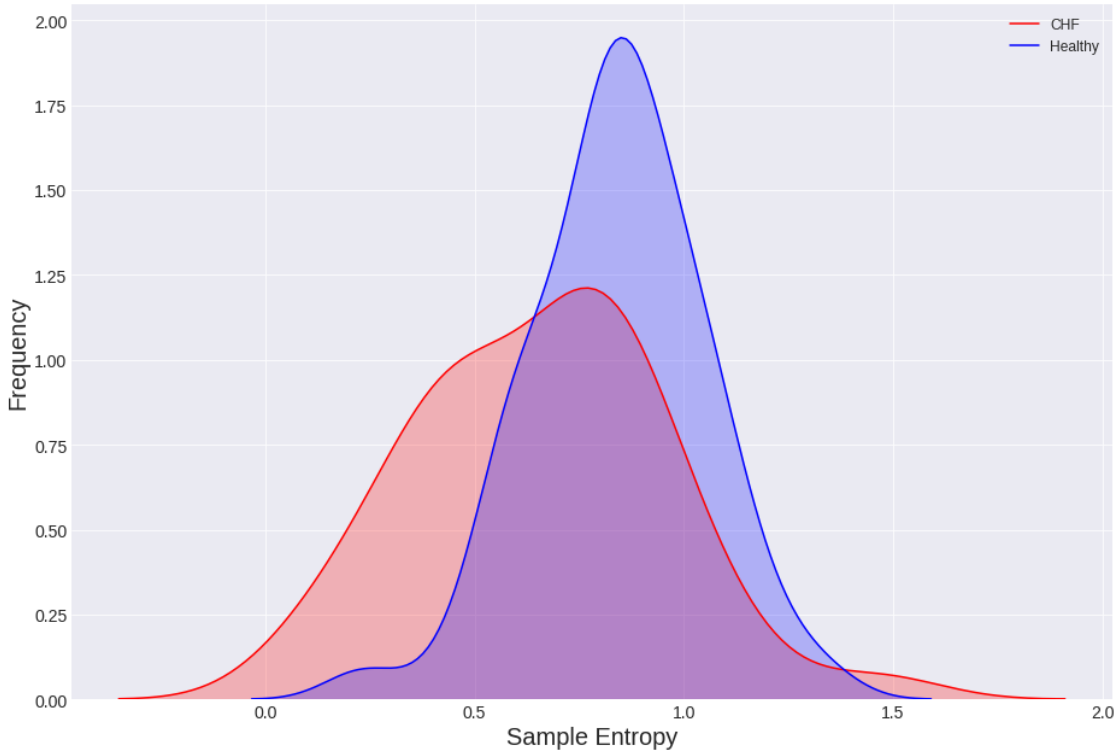
```
/home/eric/anaconda3/envs/tesina/lib/python3.7/site-packages/scipy/stats/stats.py:1713: FutureW
  return np.add.reduce(sorted[indexer] * weights, axis=axis) / sumval
/home/eric/anaconda3/envs/tesina/lib/python3.7/site-packages/statsmodels/nonparametric/kde.py:4
  X = X[np.logical_and(X > clip[0], X < clip[1])] # won't work for two columns.
/home/eric/anaconda3/envs/tesina/lib/python3.7/site-packages/statsmodels/nonparametric/kde.py:4
  X = X[np.logical_and(X > clip[0], X < clip[1])] # won't work for two columns.
```

```
Out[10]: (array([0.  , 0.25, 0.5 , 0.75, 1.  , 1.25, 1.5 , 1.75, 2.  , 2.25]),
          <a list of 10 Text yticklabel objects>)
```

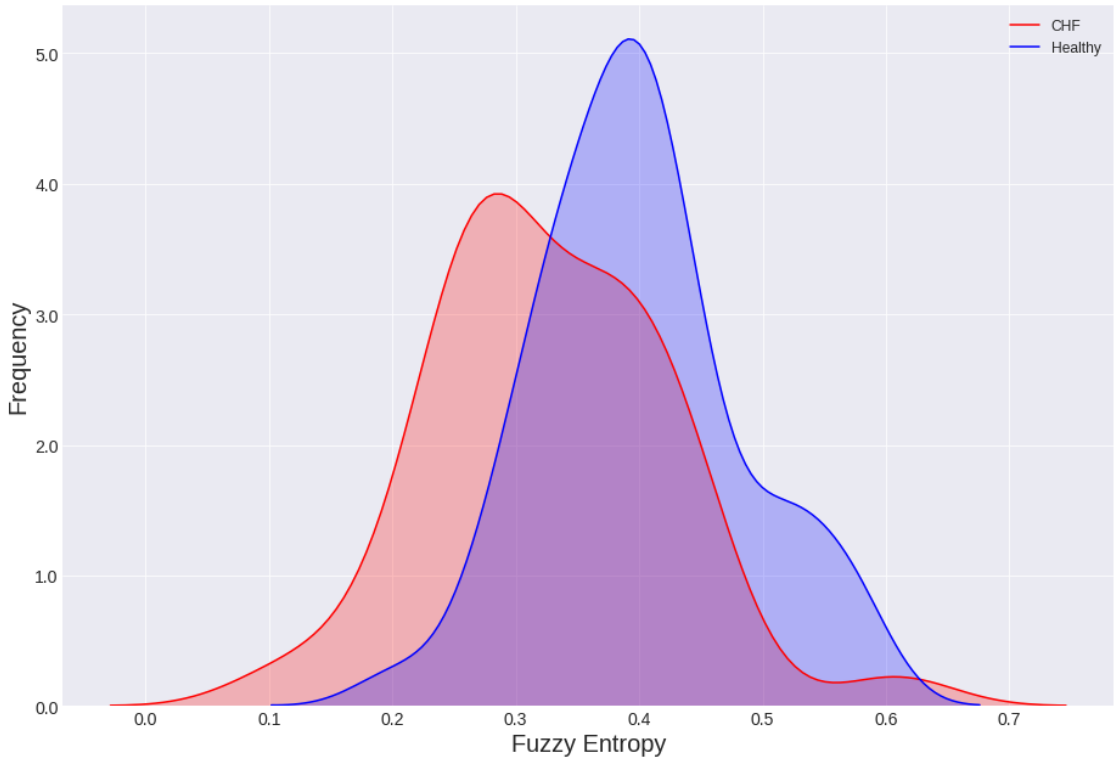



```
In [11]: # plot of 2 variables
         fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])
         p1=sns.kdeplot(dormidosCHF['SampleEntropy'], shade=True, color="r")
         p1=sns.kdeplot(dormidosH['SampleEntropy'], shade=True, color="b")
         plt.legend(['CHF','Healthy'],fontsize=12)
         plt.xlabel('Sample Entropy',fontsize=20)
         plt.ylabel('Frequency',fontsize=20)
         plt.xticks(fontsize = 14)
         plt.yticks(fontsize = 14)
         #sns.plt.show()
```

```
Out[11]: (array([0.  , 0.25, 0.5 , 0.75, 1.  , 1.25, 1.5 , 1.75, 2.  , 2.25]),
          <a list of 10 Text yticklabel objects>)
```

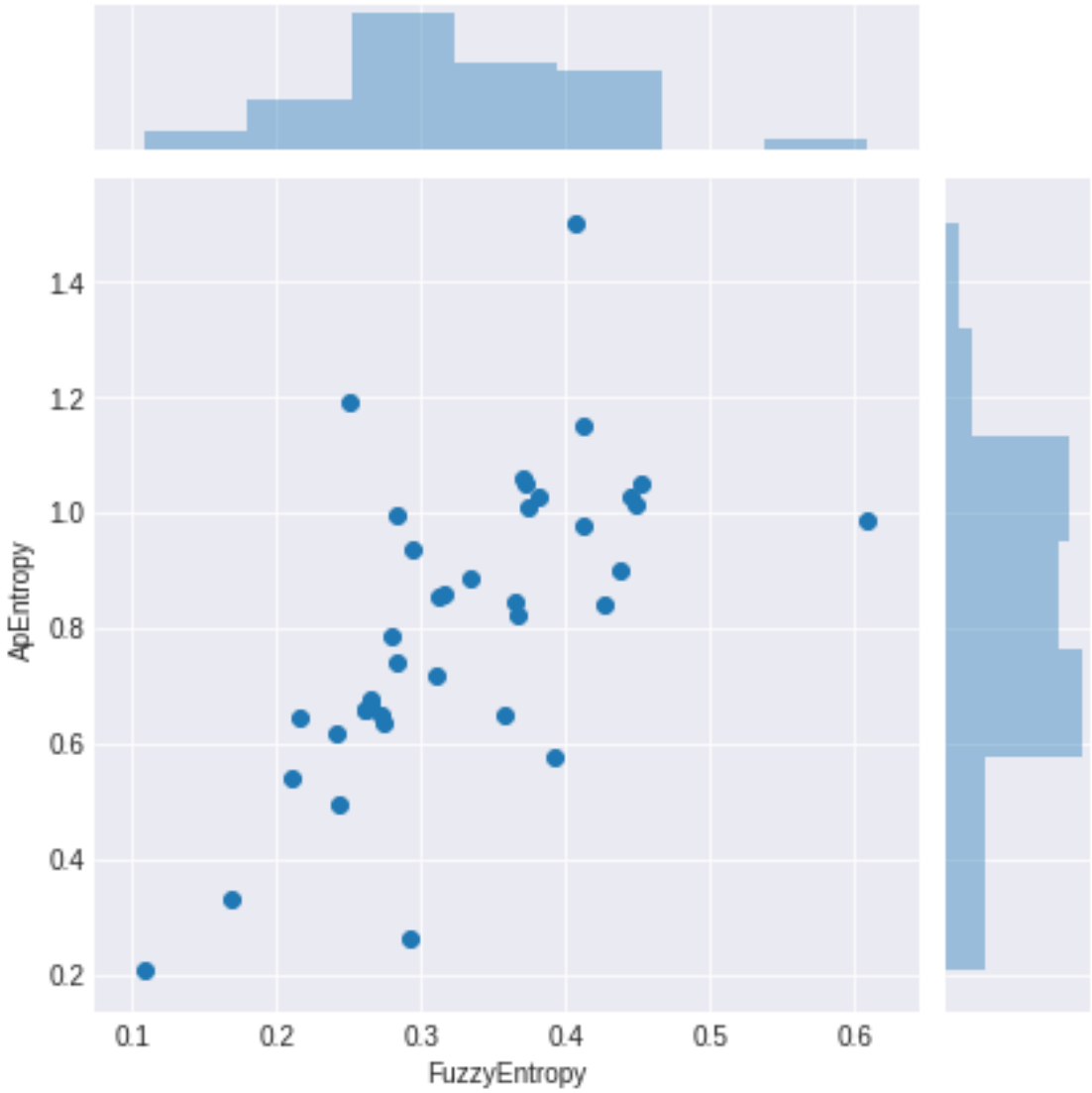



```
In [12]: # plot of 2 variables
         fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])
         p1=sns.kdeplot(dormidosCHF['FuzzyEntropy'], shade=True, color="r")
         p1=sns.kdeplot(dormidosH['FuzzyEntropy'], shade=True, color="b")
         plt.legend(['CHF','Healthy'],fontsize=12)
         plt.xlabel('Fuzzy Entropy',fontsize=20)
         plt.ylabel('Frequency',fontsize=20)
         plt.xticks(fontsize = 14)
         plt.yticks(fontsize = 14)
         axes.yaxis.set_major_formatter(FormatStrFormatter('%.1f'))
         #sns.plt.show()
```

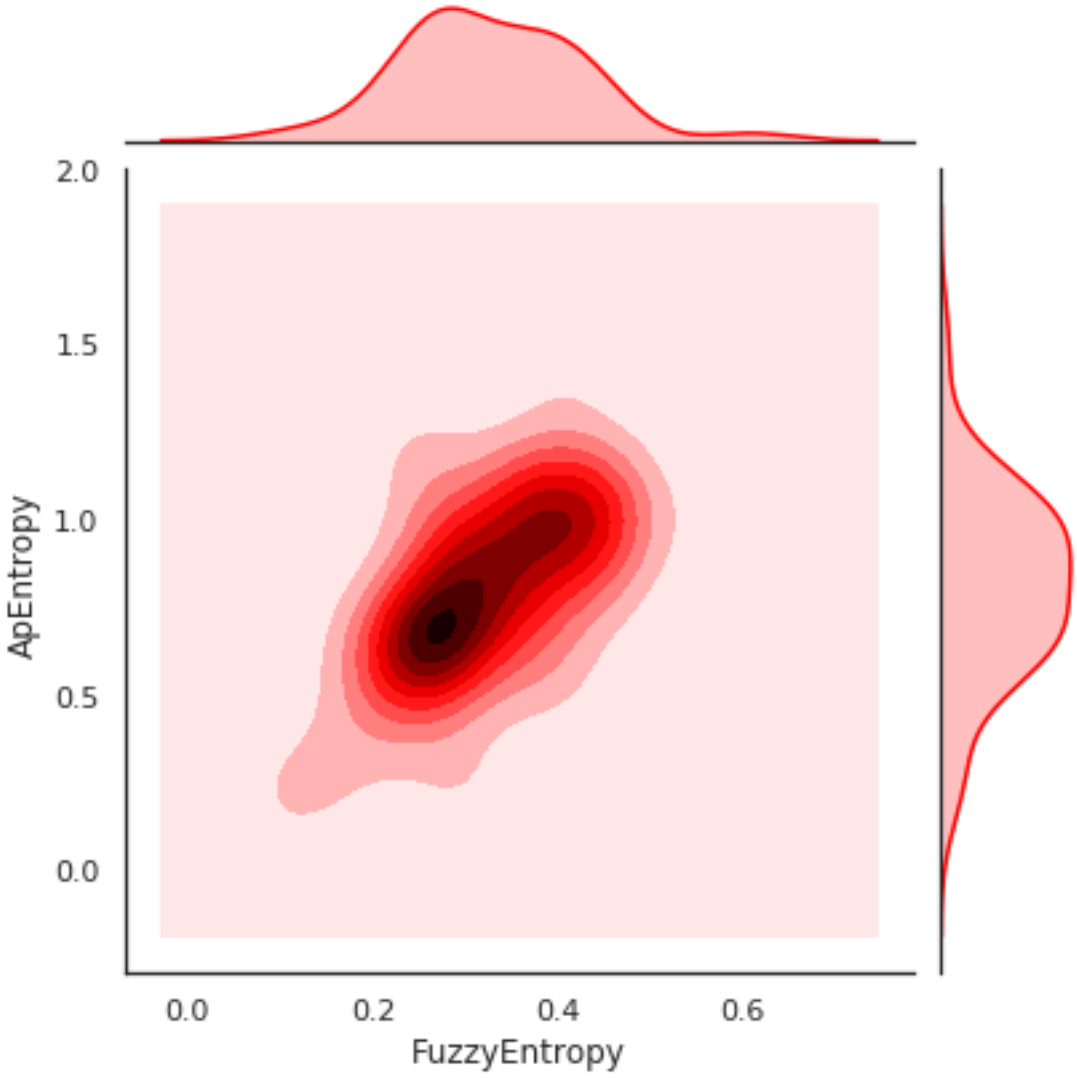


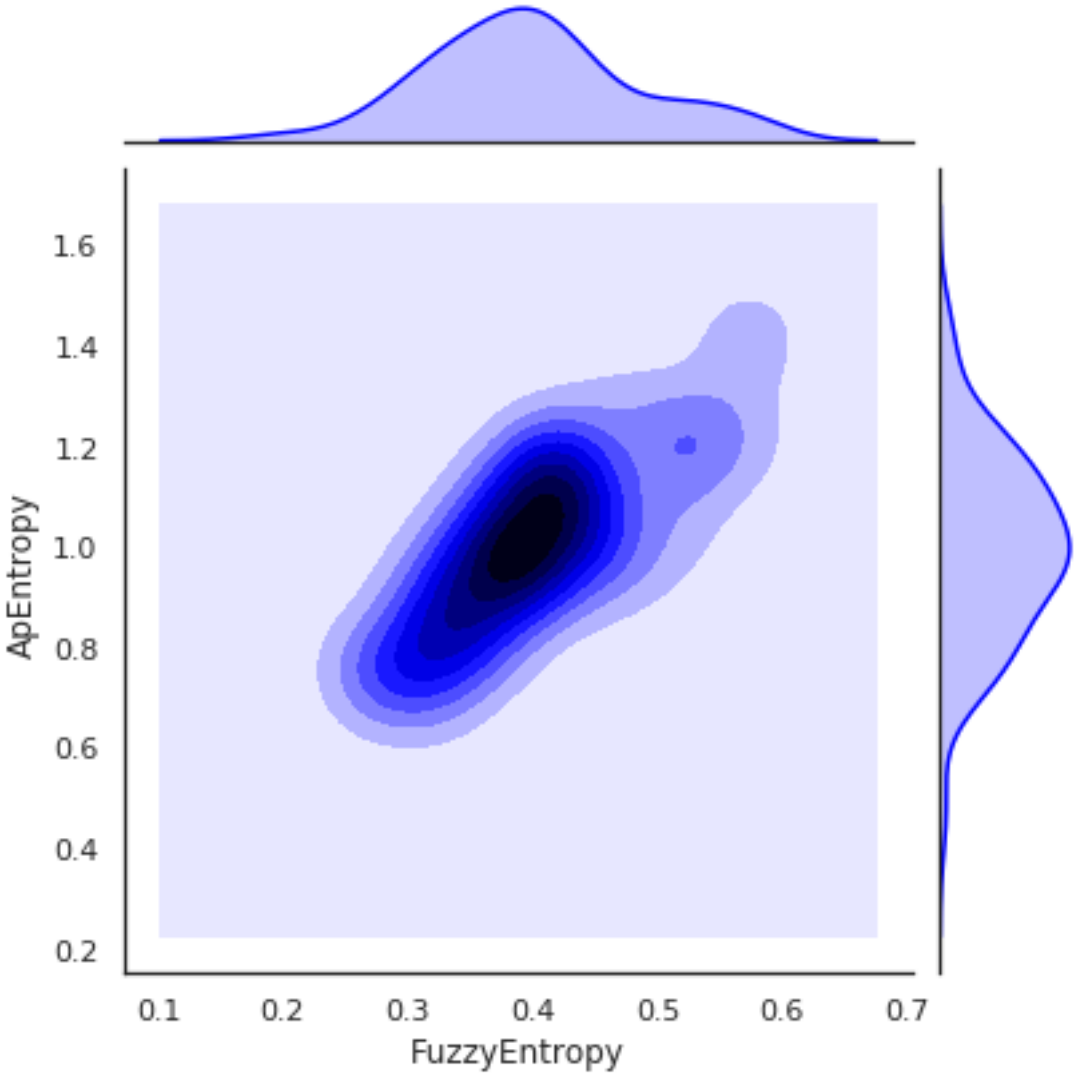

```
In [13]: sns.jointplot(x=dormidosCHF['FuzzyEntropy'], y=dormidosCHF['ApEntropy'], kind='scatte
```

```
Out[13]: <seaborn.axisgrid.JointGrid at 0x7f55f4922fd0>
```



In [14]:
```
# Custom the color
# fig=plt.figure()
# axes=fig.add_axes([0.1,0.1,2,2])
sns.set(style="white", color_codes=True)
g=sns.jointplot(x=dormidosCHF['FuzzyEntropy'], y=dormidosCHF['ApEntropy'], kind='kde'
g=sns.jointplot(x=dormidosH['FuzzyEntropy'], y=dormidosH['ApEntropy'], kind='kde', co
```


2.0
1.5
1.0
0.5
0.0
ApEntropy
0.0
0.2
0.4
0.6
FuzzyEntropy



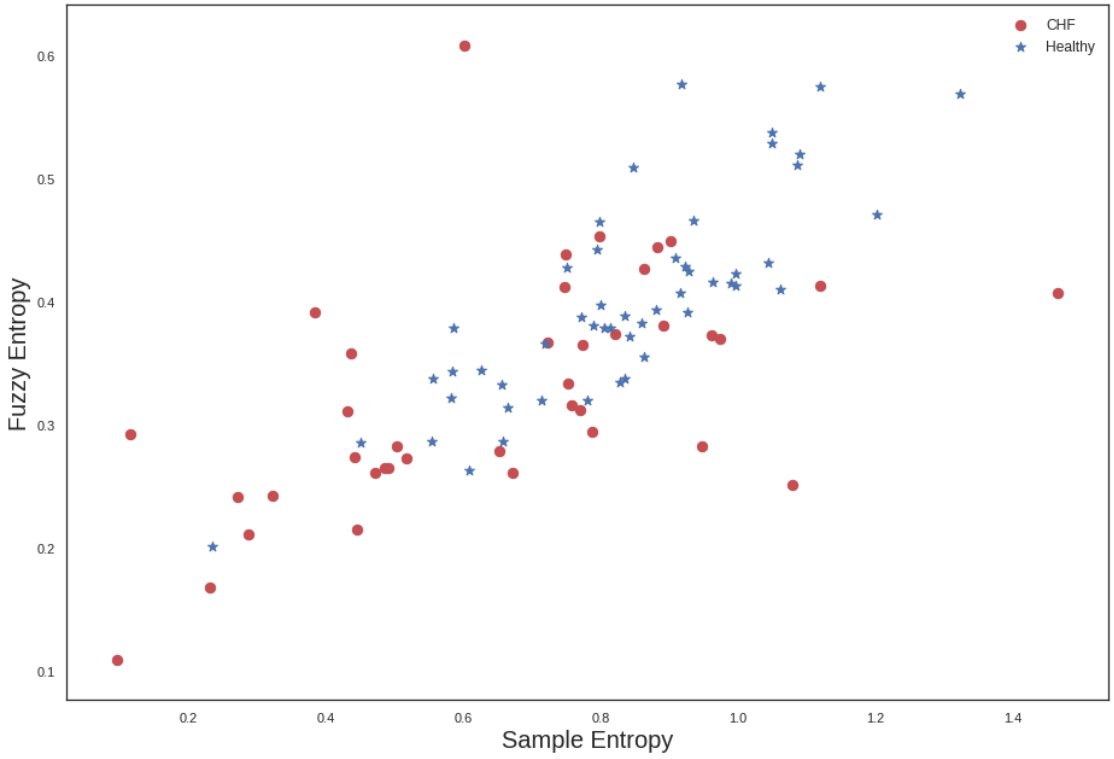
4 Gráficas de entropia vs entropia physionet

```
In [15]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])

         plt.style.use('seaborn-darkgrid')
         axes.scatter(dormidosCHF['SampleEntropy'],dormidosCHF['FuzzyEntropy'],c='r',marker='o
         axes.scatter(dormidosH['SampleEntropy'],dormidosH['FuzzyEntropy'],c='b',marker='*',s=

         plt.legend(['CHF','Healthy'],fontsize=12)
         plt.xlabel('Sample Entropy',fontsize=20)
         plt.ylabel('Fuzzy Entropy',fontsize=20)
```

Out[15]: Text(0, 0.5, 'Fuzzy Entropy')

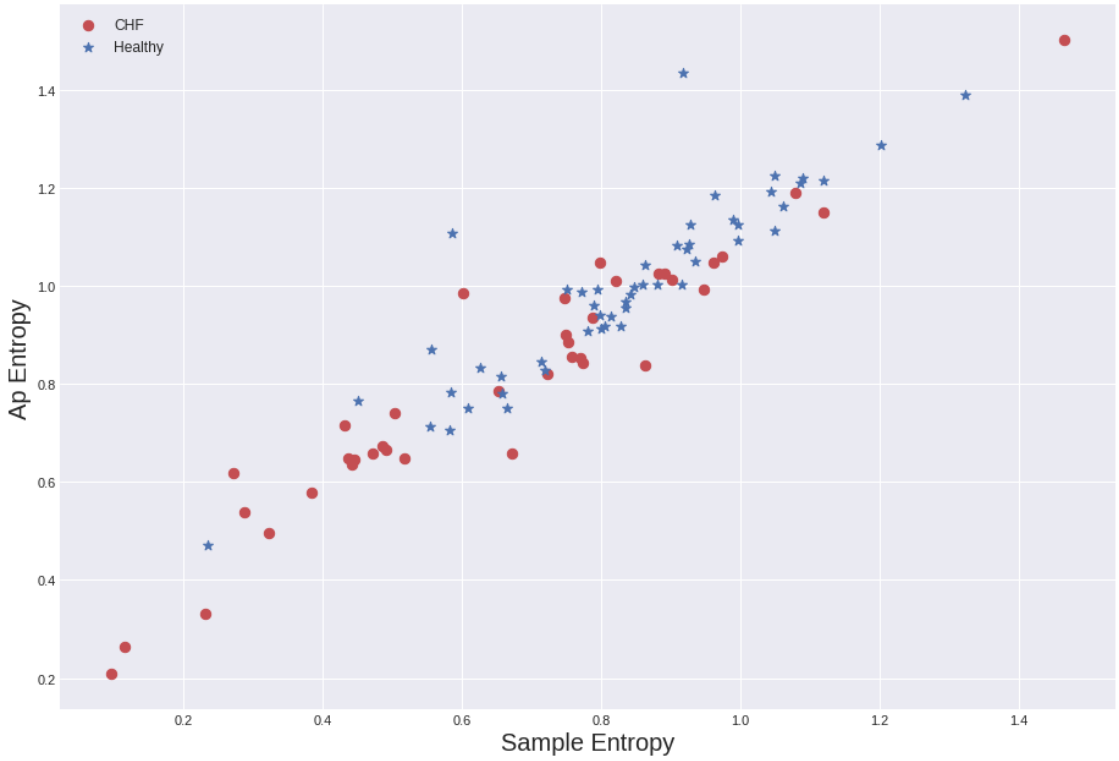


In [16]:
```
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])

plt.style.use('seaborn-darkgrid')
axes.scatter(dormidosCHF['SampleEntropy'],dormidosCHF['ApEntropy'],c='r',marker='o',s=
axes.scatter(dormidosH['SampleEntropy'],dormidosH['ApEntropy'],c='b',marker='*',s=70)

plt.legend(['CHF','Healthy'],fontsize=12)
plt.xlabel('Sample Entropy',fontsize=20)
plt.ylabel('Ap Entropy',fontsize=20)
```

Out[16]: Text(0, 0.5, 'Ap Entropy')

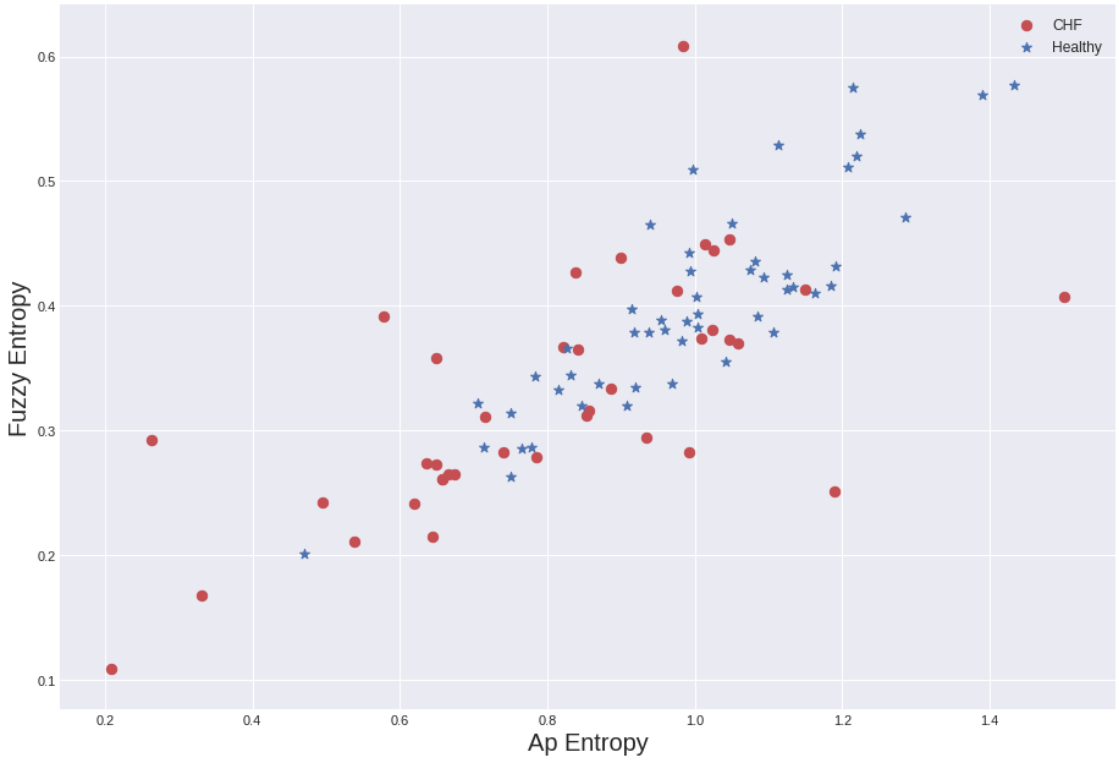



```
In [17]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])

         plt.style.use('seaborn-darkgrid')
         axes.scatter(dormidosCHF['ApEntropy'],dormidosCHF['FuzzyEntropy'],c='r',marker='o',s=
         axes.scatter(dormidosH['ApEntropy'],dormidosH['FuzzyEntropy'],c='b',marker='*',s=70);

         plt.legend(['CHF','Healthy'],fontsize=12)
         plt.xlabel('Ap Entropy',fontsize=20)
         plt.ylabel('Fuzzy Entropy',fontsize=20)

Out[17]: Text(0, 0.5, 'Fuzzy Entropy')
```



In [ ]:

In [18]:
```
meansDormidosChf = [dormidosCHF['ApEntropy'].mean(),dormidosCHF['FuzzyEntropy'].mean()
stdDormidosChf = [dormidosCHF['ApEntropy'].std(),dormidosCHF['FuzzyEntropy'].std(),dor

meansDormidosH = [dormidosH['ApEntropy'].mean(),dormidosH['FuzzyEntropy'].mean(),dormi
stdDormidosH = [dormidosH['ApEntropy'].std(),dormidosH['FuzzyEntropy'].std(),dormidosH


xAct = [0,1,2]
xLow = [0.1,1.1,2.1]


# example variable error bar values
x=[0,1,2]


plt.figure()
axes = fig.add_axes([0.1,0.1,2,2])
plt.figure(figsize=[10,6.2])
for i in range(len(meansDormidosChf)):
    plt.plot(xAct[i],meansDormidosChf[i],'ro')
    plt.errorbar(xAct[i],meansDormidosChf[i], yerr=stdDormidosChf[i],ecolor='r')
```

```
            plt.plot(xLow[i],meansDormidosH[i],'bo')
            plt.errorbar(xLow[i],meansDormidosH[i], yerr=stdDormidosH[i],ecolor='b')

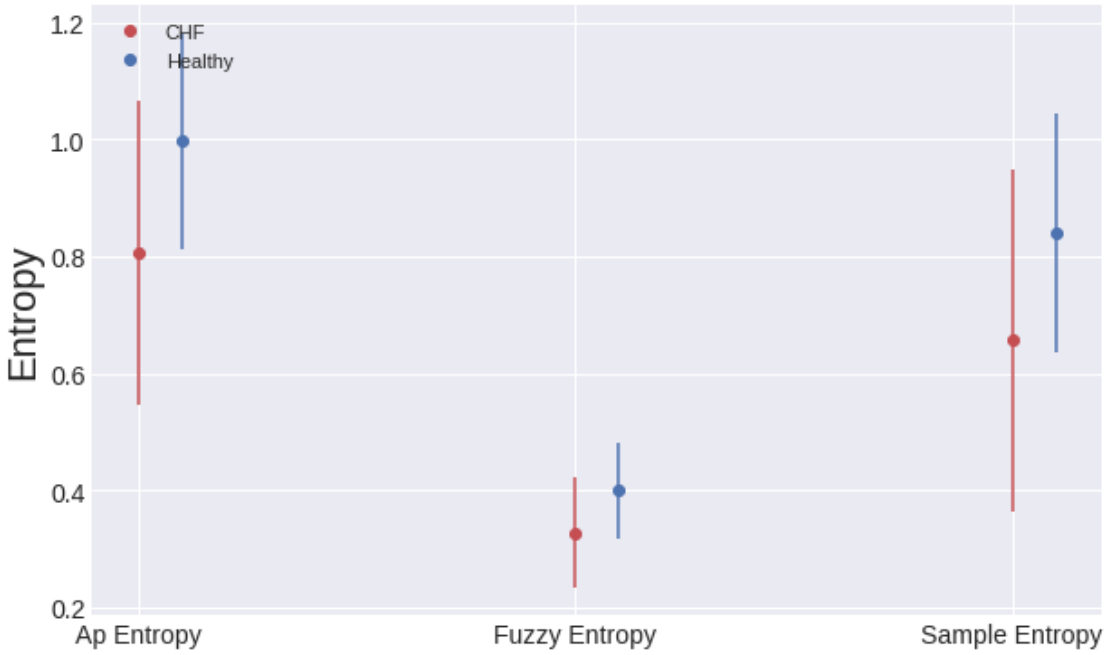
        xt=['Ap Entropy' , 'Fuzzy Entropy', 'Sample Entropy']
        plt.yticks(fontsize = 14)
        plt.xticks(x,xt,fontsize=14)
        plt.ylabel('Entropy',fontsize = 22)
        plt.legend(['CHF','Healthy'],loc='upper left')

        # First illustrate basic pyplot interface, using defaults where possible.
```

```
/home/eric/anaconda3/envs/tesina/lib/python3.7/site-packages/matplotlib/figure.py:98: Matplotli
Adding an axes using the same arguments as a previous axes currently reuses the earlier instanc
  "Adding an axes using the same arguments as a previous axes "
```

Out[18]: <matplotlib.legend.Legend at 0x7f56089aeb70>

```
<Figure size 432x288 with 0 Axes>
```



In [ ]:

5 Gráficas comparativas entre entropias en pruebas de esfuerzo

```
In [19]: jovenes=pd.read_csv('/home/eric/Documents/TimeSeries/SERIES_DE_TIEMPO_COMPLETO/Series
         adultos=pd.read_csv('/home/eric/Documents/TimeSeries/SERIES_DE_TIEMPO_COMPLETO/Series
```

```
print(len(jovenes))
print(len(adultos))
```

```
31
8
```

In [20]:
```
adultosHigh=adultos.loc[adultos['Cuestionario']=='HIGH']
jovenesHigh=jovenes.loc[jovenes['Cuestionario']=='HIGH']
adultosLow=adultos.loc[adultos['Cuestionario']=='LOW']
jovenesLow=jovenes.loc[jovenes['Cuestionario']=='LOW']
jovenesHigh
```

Out[20]:

	Genero	Persona	Edad	Talla	Peso	IMC	Cuestionario	ReposoSamp	\
8	H	Edgar	21	1.80	72.0	22.222220	HIGH	0.8635	
9	H	enrique 1	23	1.72	73.0	24.675500	HIGH	1.3663	
10	H	enrique 2	23	1.72	73.0	24.675500	HIGH	1.1434	
11	H	enrique 3	23	1.72	73.0	24.675500	HIGH	0.9828	
12	H	Jardi	22	1.75	66.0	21.551020	HIGH	0.7543	
14	H	Jorge	21	1.80	85.0	26.234568	HIGH	0.6985	

	3.5MPHSamp	4MPHSamp	...	4MPHAp	PendienteAp	AVGr	PNN50r	\
8	1.1731	1.1539	...	1.0793	0.2510	0.624805	0.044966	
9	1.8354	1.3585	...	1.0321	-0.1658	0.839953	0.077224	
10	1.5081	1.3231	...	1.0940	-0.0607	0.868297	0.169110	
11	0.7841	0.3081	...	0.5312	-0.4641	0.758305	0.043988	
12	1.3291	1.0608	...	1.1789	0.0066	0.668625	0.198436	
14	0.9581	0.7908	...	0.9476	-0.0038	0.696195	0.130987	

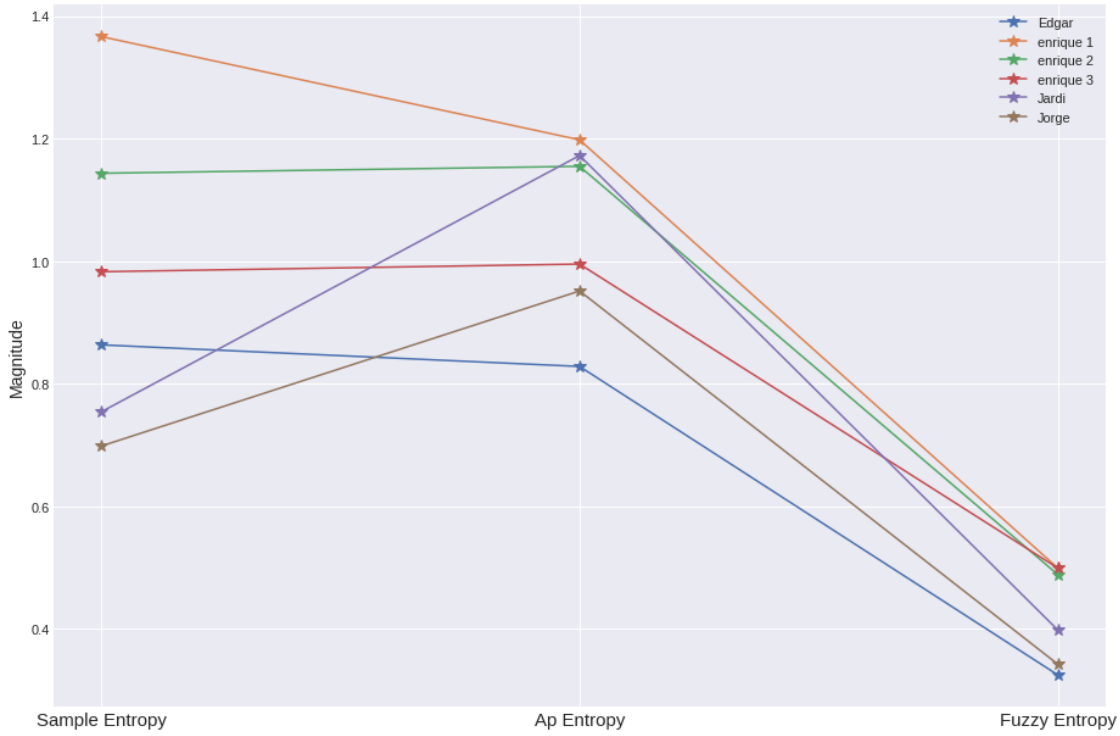
	RMSSDr	SDNNr	AVGp	PNN50p	RMSSDp	SDNNp
8	0.048860	0.048019	0.519125	0.000000	0.008159	0.018516
9	0.031659	0.061385	0.532680	0.002933	0.011927	0.028793
10	0.037462	0.080737	0.525594	0.001955	0.010328	0.023218
11	0.059873	0.064302	0.615844	0.267840	0.277208	0.203213
12	0.051698	0.105750	0.462742	0.000978	0.008430	0.021342
14	0.046978	0.080610	0.425719	0.002933	0.010064	0.008827

[6 rows x 27 columns]

In [21]:
```
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])
x=[0,1,2]
xt=['Sample Entropy','Ap Entropy','Fuzzy Entropy']
for index,row in jovenesHigh.iterrows():
    jov=[row['ReposoSamp'],row['ReposoAp'],row['ReposoFuzz']]
    axes.plot(jov, '*-', markersize=10)
axes.legend(jovenesHigh['Persona'])
plt.xticks(x,xt,fontsize=15)
```

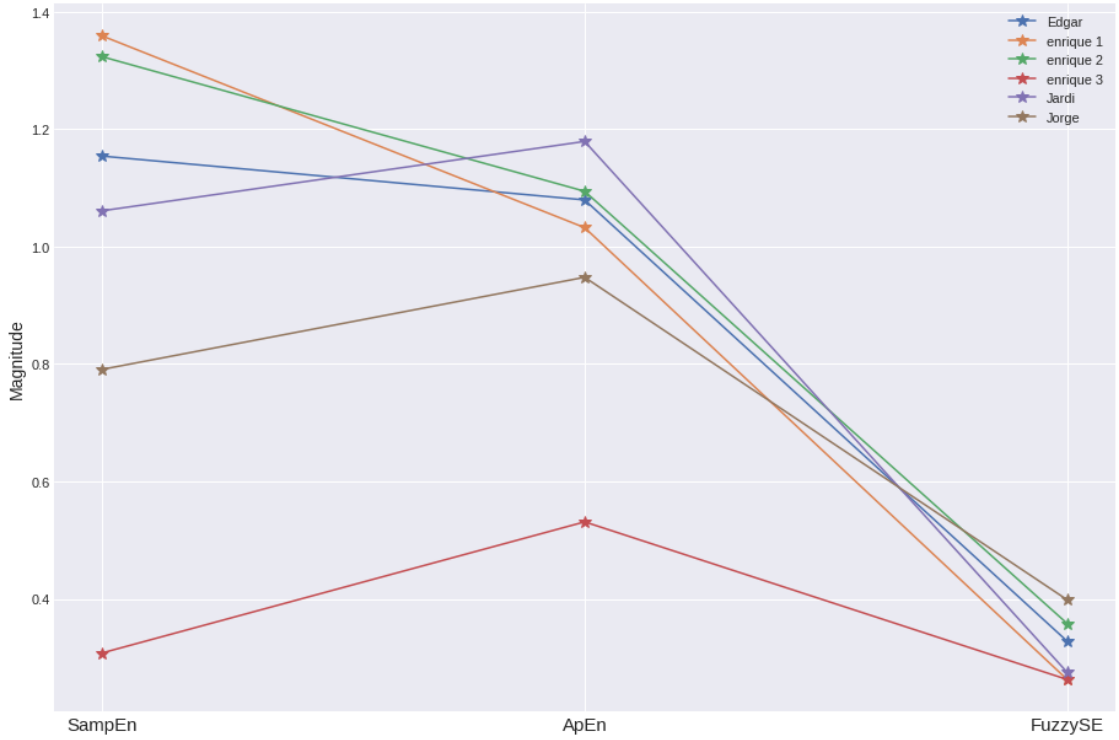
```
plt.title('',fontsize=16)
plt.ylabel('Magnitude',fontsize=14)
```

```
Out[21]: Text(0, 0.5, 'Magnitude')
```




```
In [22]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])
         x=[0,1,2]
         xt=['SampEn','ApEn','FuzzySE']
         for index,row in jovenesHigh.iterrows():
             jov=[float(row['4MPHSamp']),float(row['4MPHAp']),float(row['4MPHFuzz'])]
             axes.plot(jov, '*-', markersize=10)
         axes.legend(jovenesHigh['Persona'])
         plt.xticks(x,xt,fontsize=15)
         plt.title('',fontsize=16)
         plt.ylabel('Magnitude',fontsize=14)
```

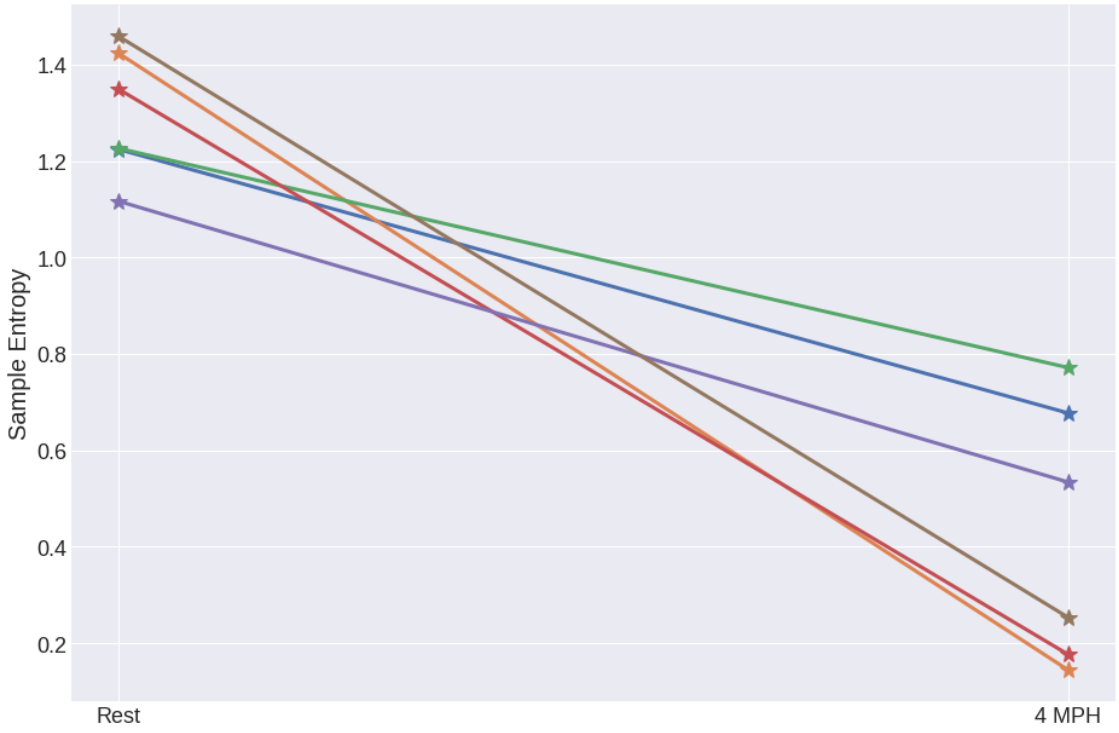
```
Out[22]: Text(0, 0.5, 'Magnitude')
```



6 Gráficas de repetibilidad de los métodos

```
In [22]: Amparo=jovenes[jovenes['Persona'].str.contains("Amp")]
         fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])
         x=[0,1]
         xt=['Rest','4 MPH',]
         for index,row in Amparo.iterrows():
             jov=[float(row['ReposoSamp']),float(row['4MPHSamp'])]
             axes.plot(jov, '*-', markersize=14, lw=3)
         # axes.legend(Amparo['Persona'])
         plt.xticks(x,xt,fontsize=15)
         plt.title('',fontsize=16)
         plt.ylabel('Sample Entropy',fontsize=20)
         plt.yticks(fontsize = 18)
         plt.xticks(fontsize = 18)

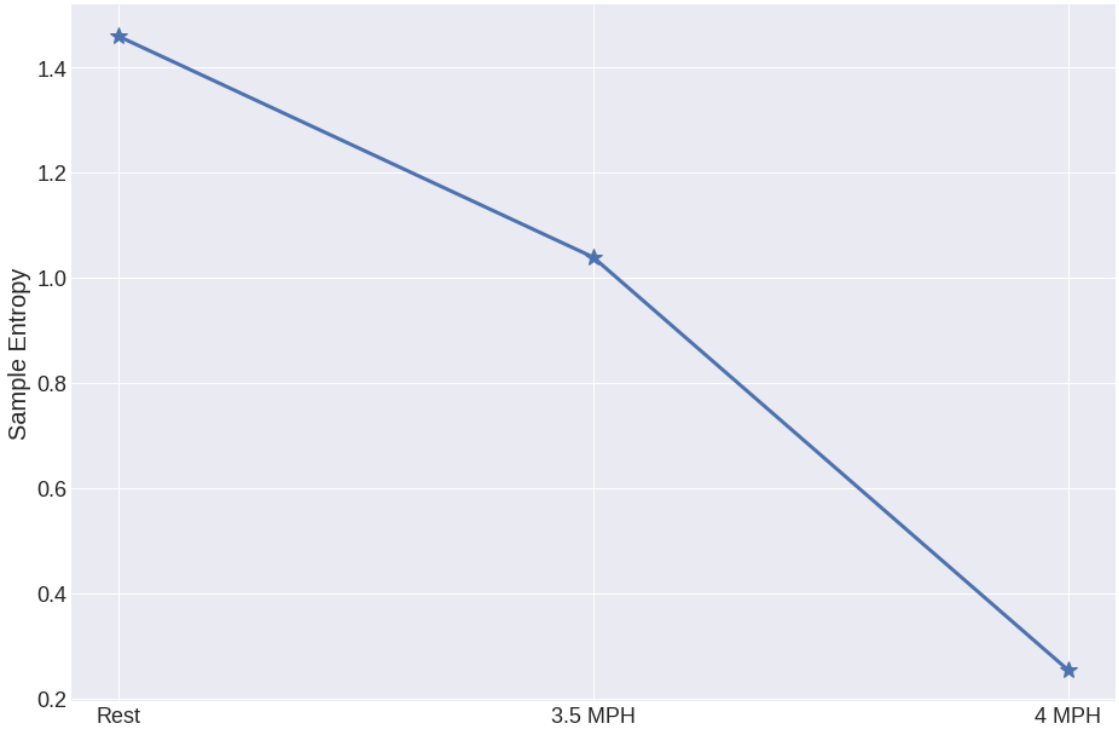
Out[22]: (array([0, 1]), <a list of 2 Text xticklabel objects>)
```



In [23]:
```
Amparo=jovenes[jovenes['Persona'].str.contains("Amp")]
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])
x=[0,1,2]
xt=['Rest','3.5 MPH','4 MPH',]

jov=[float(row['ReposoSamp']),float(row['3.5MPHSamp']),float(row['4MPHSamp'])]
axes.plot(jov, '*-', markersize=14, lw=3)
# axes.legend(Amparo['Persona'])
plt.xticks(x,xt,fontsize=15)
plt.title('',fontsize=16)
plt.ylabel('Sample Entropy',fontsize=20)
plt.yticks(fontsize = 18)
plt.xticks(fontsize = 18)
```

Out[23]:
```
(array([0, 1, 2]), <a list of 3 Text xticklabel objects>)
```



In [24]: Amparo

Out[24]:

	Genero	Persona	Edad	Talla	Peso	IMC	Cuestionario	ReposoSamp	\
0	M	Amparo2	22	1.55	48.0	19.979188	LOW	1.2246	
1	M	Amparo3	22	1.55	48.0	19.979188	LOW	1.4239	
3	M	Amparo5	22	1.55	48.0	19.979188	LOW	1.2267	
4	M	Amparo6	22	1.55	48.0	19.979188	LOW	1.3495	
5	M	Amparo7	22	1.55	48.0	19.979188	LOW	1.1170	
6	M	Amparo8	22	1.55	48.0	19.979188	LOW	1.4590	

	3.5MPHSamp	4MPHSamp	...	4MPHAp	PendienteAp	AVGr	PNN50r	\
0	0.1814	0.6777	...	0.8773	-0.5719	0.827102	0.325513	
1	0.1370	0.145	...	0.1946	-1.1138	0.668367	0.156403	
3	1.8386	0.7719	...	0.6022	-1.1351	0.806219	0.291300	
4	0.8812	0.1772	...	0.2620	-0.9780	0.684028	0.097952	
5	1.7558	0.5345	...	0.6698	-0.3872	0.731750	0.063539	
6	1.0388	0.254	...	0.3600	-0.9093	0.896938	0.438905	

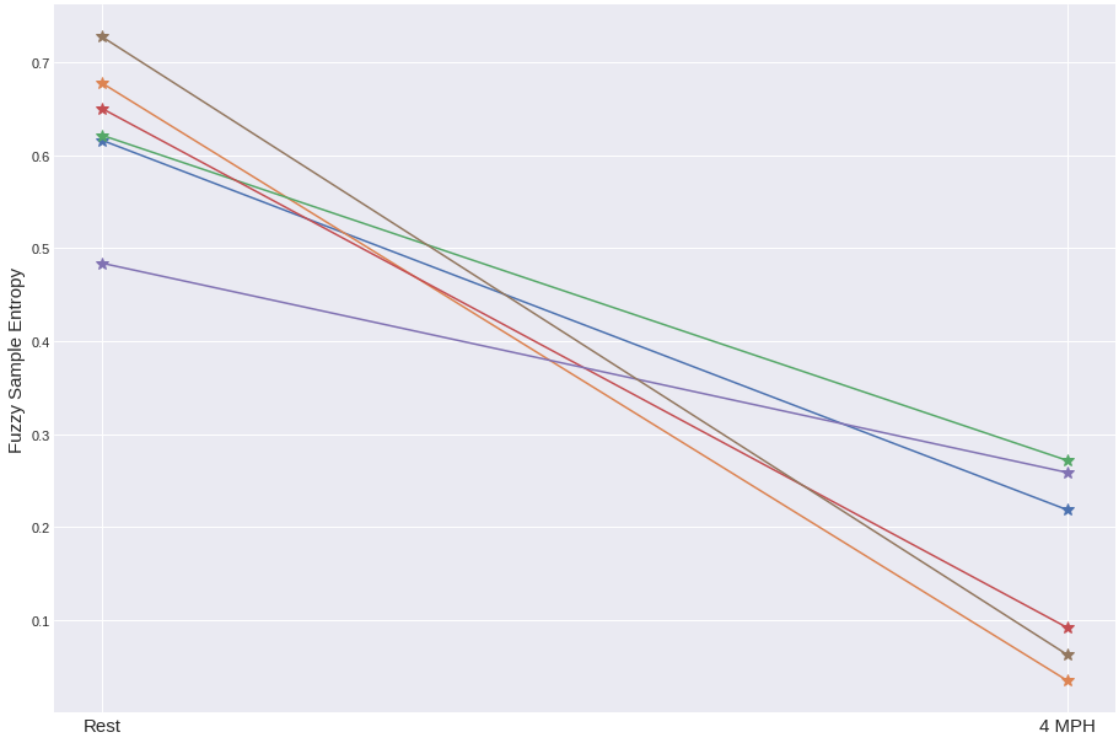
	RMSSDr	SDNNr	AVGp	PNN50p	RMSSDp	SDNNp
0	0.055137	0.060082	0.400148	0.000000	0.006198	0.011765
1	0.039949	0.053411	0.447398	0.035191	0.121386	0.086467
3	0.057789	0.078291	0.428664	0.000000	0.006357	0.012745
4	0.030769	0.043573	0.469297	0.067449	0.141092	0.097246
5	0.028946	0.058900	0.531367	0.007820	0.017392	0.027319

```
6  0.072224  0.083673  0.490055  0.086022  0.145969  0.104154

[6 rows x 27 columns]
```

In [25]:
```
Amparo=jovenes[jovenes['Persona'].str.contains("Amp")]
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])
x=[0,1]
xt=['Rest','4 MPH',]
for index,row in Amparo.iterrows():
    jov=[float(row['ReposoFuzz']),float(row['4MPHFuzz'])]
    axes.plot(jov, '*-', markersize=10)
# axes.legend(Amparo['Persona'])
plt.xticks(x,xt,fontsize=15)
plt.title('',fontsize=16)
plt.ylabel('Fuzzy Sample Entropy',fontsize=15)
```

Out[25]:
```
Text(0, 0.5, 'Fuzzy Sample Entropy')
```

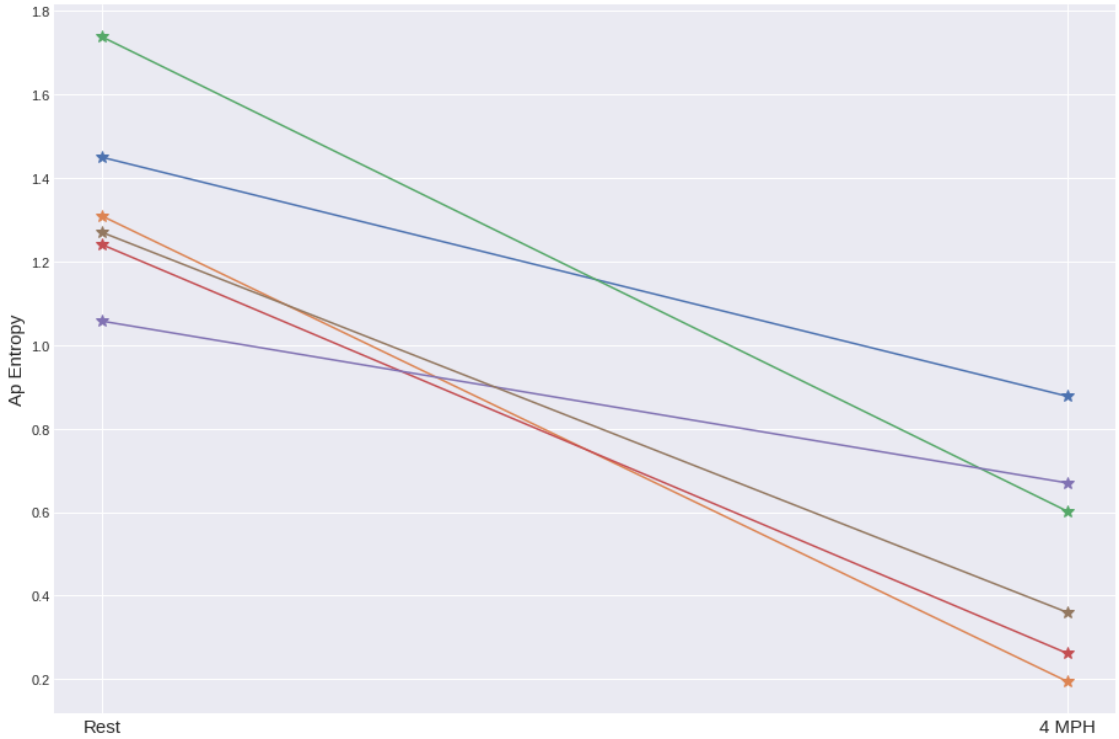


In [26]:
```
Amparo=jovenes[jovenes['Persona'].str.contains("Amp")]
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])
x=[0,1]
xt=['Rest','4 MPH',]
```

```
        for index,row in Amparo.iterrows():
            jov=[float(row['ReposoAp']),float(row['4MPHAp'])]
            print(jov)
            axes.plot(jov, '*-', markersize=10)
        # axes.legend(Amparo['Persona'])
        plt.xticks(x,xt,fontsize=15)
        plt.title('',fontsize=16)
        plt.ylabel('Ap Entropy',fontsize=15)
```

```
[1.4492, 0.8773]
[1.3084, 0.1946]
[1.7373, 0.6022]
[1.24, 0.262]
[1.057, 0.6698]
[1.2693, 0.36]
```

Out[26]: Text(0, 0.5, 'Ap Entropy')

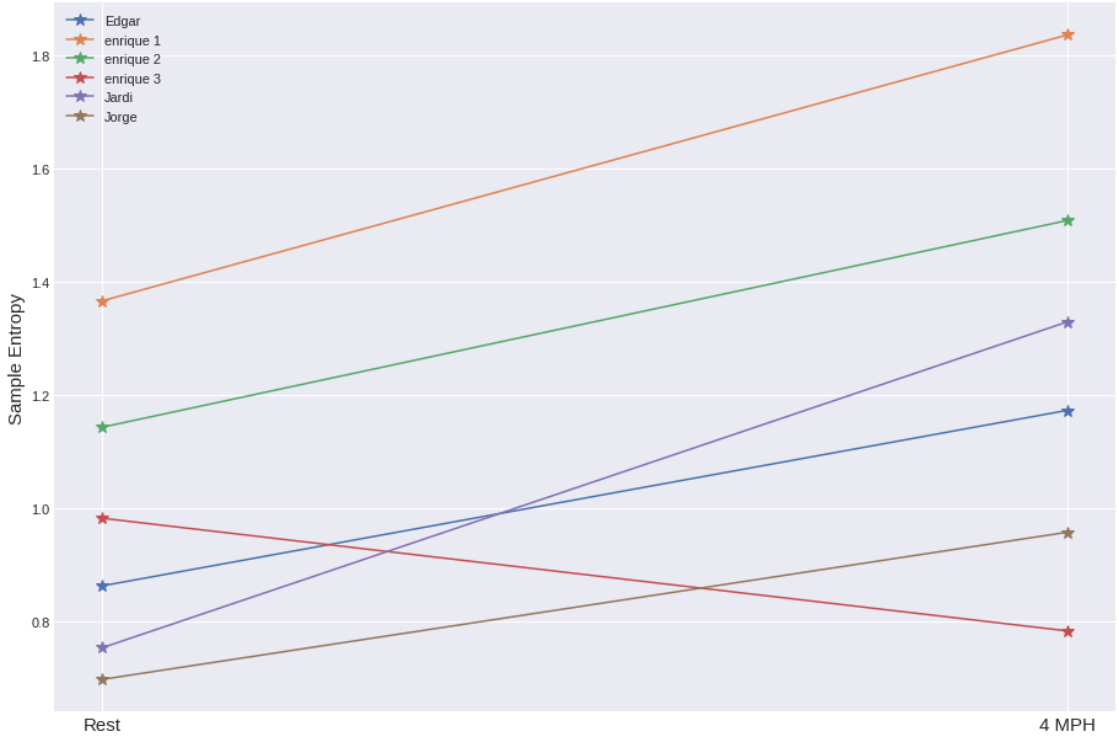


7 Cambio de entropia en pruebas de esfuerzo

In [27]:
```
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])
```

```
x=[0,1]
xt=['Rest','4 MPH']
Jov=jovenes[jovenes['Cuestionario']=="HIGH"]
for index,row in Jov.iterrows():
    if row['4MPH'=='?']:
        jov=[float(row['ReposoSamp']),float(row['3.5MPHSamp'])]
    else:
        jov=[float(row['ReposoSamp']),float(row['4MPHSamp'])]
    axes.plot(jov, '*-', markersize=10)
axes.legend(Jov['Persona'])
plt.xticks(x,xt,fontsize=15)
plt.title('',fontsize=16)
plt.ylabel('Sample Entropy',fontsize=15)
```

Out[27]: Text(0, 0.5, 'Sample Entropy')



In [25]: print(Jov[Jov['Persona']=='enrique 3'])

```
   Genero     Persona  Edad  Talla  Peso       IMC Cuestionario  ReposoSamp  \
11      H  enrique 3    23   1.72   73.0  24.6755         HIGH      0.9828

    3.5MPHSamp 4MPHSamp     ...      4MPHAp  PendienteAp      AVGr    PNN50r  \
11      0.7841   0.3081     ...      0.5312      -0.4641  0.758305  0.043988
```

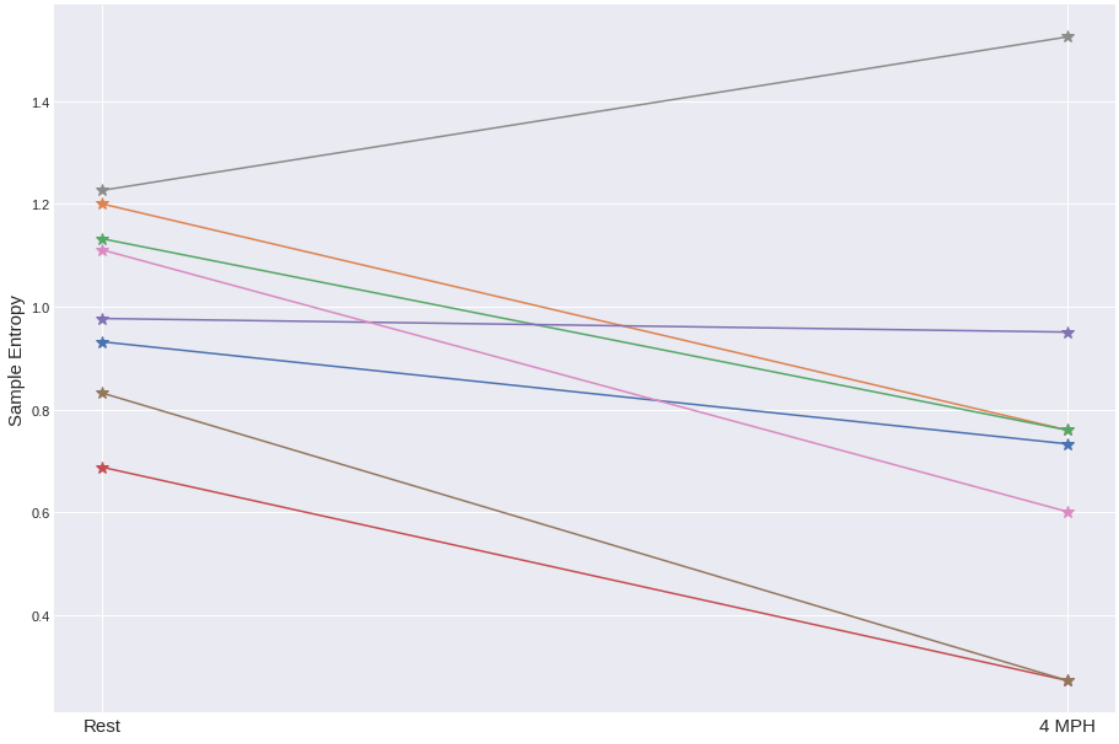
```
      RMSSDr     SDNNr       AVGp    PNN50p     RMSSDp     SDNNp
11  0.059873  0.064302  0.615844   0.26784  0.277208  0.203213

[1 rows x 27 columns]
```

In [26]:
```
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])
x=[0,1]
plt.style.use('seaborn-darkgrid')

xt=['Rest','4 MPH']
for index,row in adultos.iterrows():
    if row['4MPH'=='?']:
        jov=[float(row['ReposoAp']),float(row['3.5MPHAp'])]
    else:
        jov=[float(row['ReposoAp']),float(row['4MPHAp'])]
    axes.plot(jov, '*-', markersize=10)
# axes.legend(adultos['Persona'])
plt.xticks(x,xt,fontsize=15)
plt.title('',fontsize=16)
plt.ylabel('Sample Entropy',fontsize=15)
```

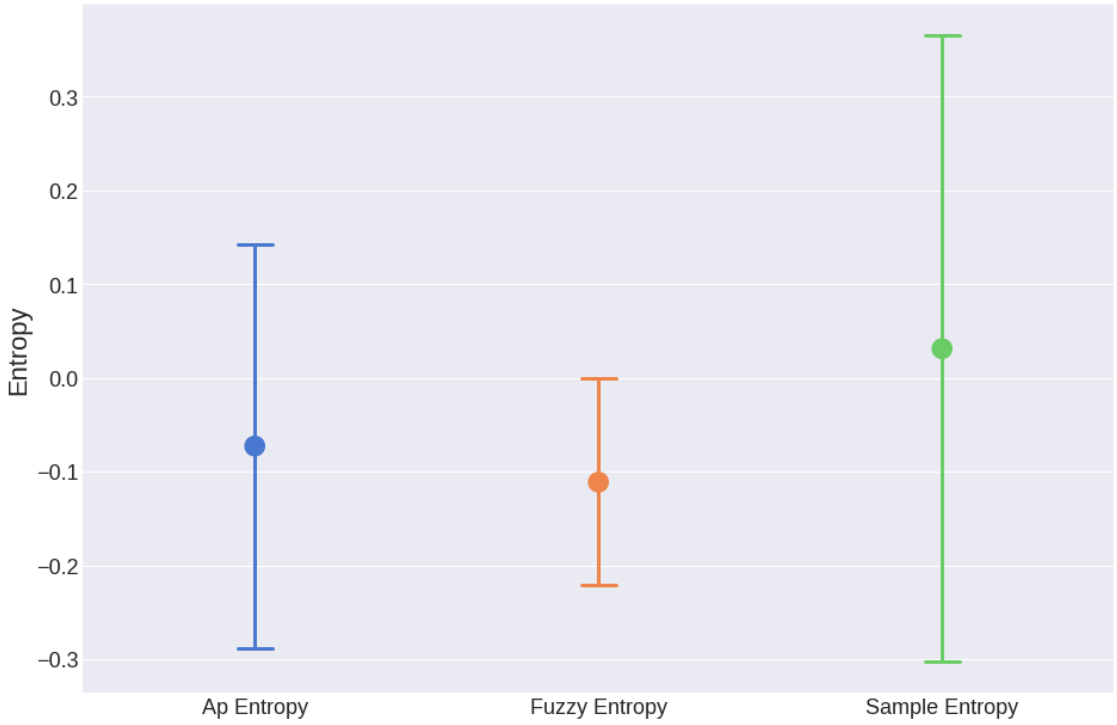
Out[26]:
```
Text(0, 0.5, 'Sample Entropy')
```



7.1 Jovenes Activos

```
In [28]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])
         df = jovenesHigh[['PendienteAp', 'PendienteFuzz', 'PendienteSamp']]
         sns.pointplot(data=df, dodge=True, join=False, ci='sd',
                       palette='muted',capsize=.1, errwidth =3,scale=2, marker ='*')
         x=[0,1,2]
         xt=['Ap Entropy' , 'Fuzzy Entropy', 'Sample Entropy']
         plt.yticks(fontsize = 18)
         plt.xticks(x,xt,fontsize=18)
         plt.ylabel('Entropy',fontsize = 22)
```

```
Out[28]: Text(0, 0.5, 'Entropy')
```

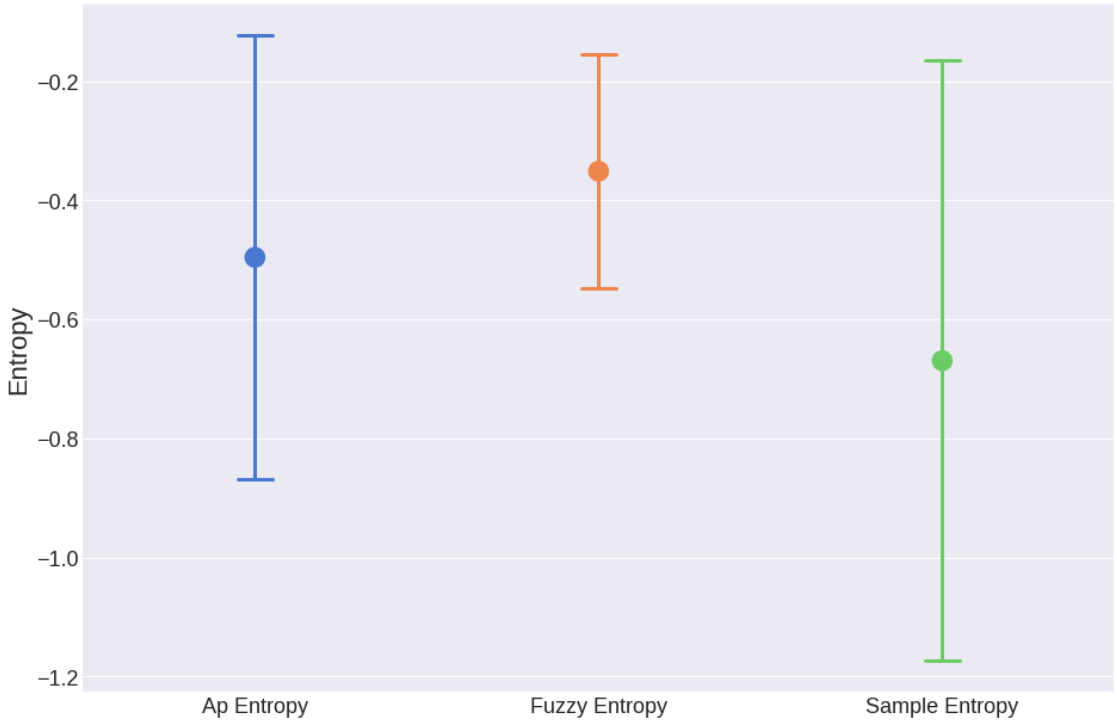


7.2 Jovenes sedentarios

```
In [30]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])
         df = jovenesLow[['PendienteAp', 'PendienteFuzz', 'PendienteSamp']]
         sns.pointplot(data=df, dodge=True, join=False, ci='sd',
                       palette='muted',capsize=.1, errwidth =3,scale=2)
         x=[0,1,2]
         xt=['Ap Entropy' , 'Fuzzy Entropy', 'Sample Entropy']
         plt.yticks(fontsize = 18)
```

```
plt.xticks(x,xt,fontsize=18)
plt.ylabel('Entropy',fontsize = 22)
```

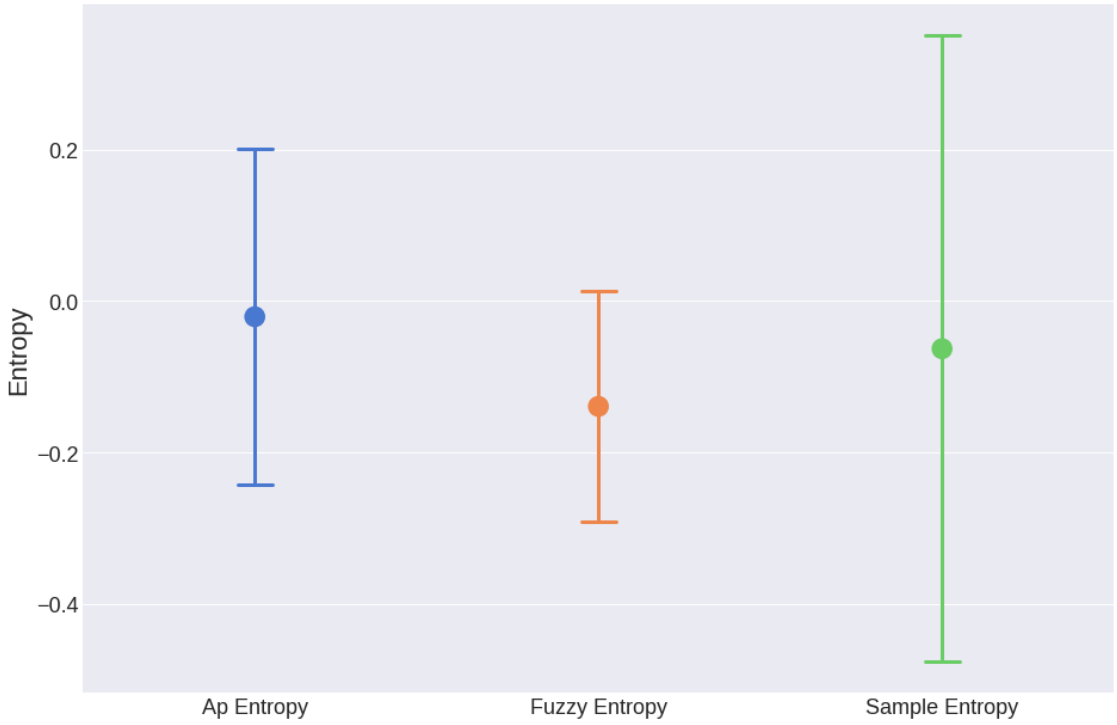
```
Out[30]: Text(0, 0.5, 'Entropy')
```



7.3 Total Activos

```
In [34]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])
         df = ActComplete[['PendienteAp', 'PendienteFuzz', 'PendienteSamp']]
         sns.pointplot(data=df, dodge=True, join=False, ci='sd',
                       palette='muted',capsize=.1, errwidth =3,scale=2)
         x=[0,1,2]
         xt=['Ap Entropy' , 'Fuzzy Entropy', 'Sample Entropy']
         plt.yticks(fontsize = 18)
         plt.xticks(x,xt,fontsize=18)
         plt.ylabel('Entropy',fontsize = 22)
```

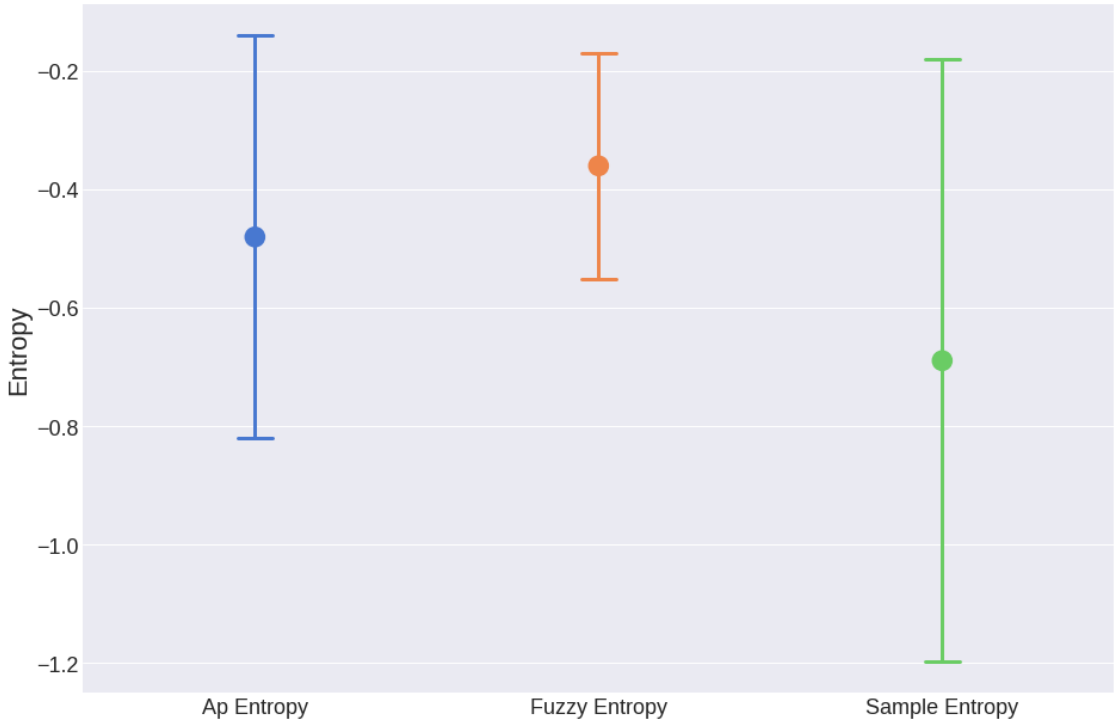
```
Out[34]: Text(0, 0.5, 'Entropy')
```



7.4 Total sedentarios

```
In [35]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])
         df = LowComplete[['PendienteAp', 'PendienteFuzz', 'PendienteSamp']]
         sns.pointplot(data=df, dodge=True, join=False, ci='sd',
                       palette='muted',capsize=.1, errwidth =3,scale=2)
         x=[0,1,2]
         xt=['Ap Entropy' , 'Fuzzy Entropy', 'Sample Entropy']
         plt.yticks(fontsize = 18)
         plt.xticks(x,xt,fontsize=18)
         plt.ylabel('Entropy',fontsize = 22)

Out[35]: Text(0, 0.5, 'Entropy')
```



In [102]:
```
meansAct = [ActComplete['PendienteAp'].mean(),ActComplete['PendienteFuzz'].mean(),Act
stdAct = [ActComplete['PendienteAp'].std(),ActComplete['PendienteFuzz'].std(),ActComp

meansLow = [LowComplete['PendienteAp'].mean(),LowComplete['PendienteFuzz'].mean(),Low
stdLow = [LowComplete['PendienteAp'].std(),LowComplete['PendienteFuzz'].std(),LowComp


xAct = [0,1,2]
xLow = [0.1,1.1,2.1]


# example variable error bar values
x=[0,1,2]


plt.figure()
axes = fig.add_axes([0.1,0.1,2,2])
plt.figure(figsize=[10,6.2])
for i in range(len(meansAct)):
    plt.plot(xAct[i],meansAct[i],'ro')
    plt.errorbar(xAct[i],meansAct[i], yerr=stdAct[i],ecolor='r')
    plt.plot(xLow[i],meansLow[i],'bo')
    plt.errorbar(xLow[i],meansLow[i], yerr=stdLow[i],ecolor='b')
```

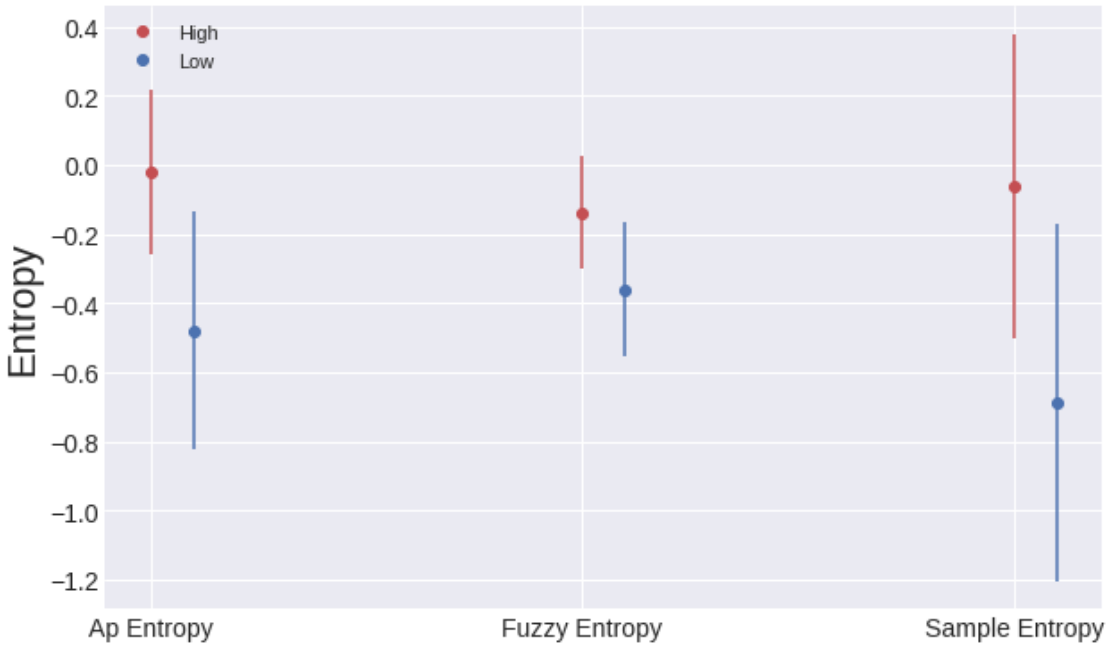
```
xt=['Ap Entropy' , 'Fuzzy Entropy', 'Sample Entropy']
plt.yticks(fontsize = 14)
plt.xticks(x,xt,fontsize=14)
plt.ylabel('Entropy',fontsize = 22)
plt.legend(['High','Low'],loc='upper left')

# First illustrate basic pyplot interface, using defaults where possible.
```

```
/home/eric/anaconda3/envs/tesina/lib/python3.7/site-packages/matplotlib/figure.py:98: Matplotli
Adding an axes using the same arguments as a previous axes currently reuses the earlier instanc
  "Adding an axes using the same arguments as a previous axes "
```

Out[102]: <matplotlib.legend.Legend at 0x7fd8c3e257b8>

```
<Figure size 432x288 with 0 Axes>
```



In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

```
In [ ]:

In [ ]:

In [ ]: fig=plt.figure()
        axes=fig.add_axes([0.1,0.1,2,2])
        sns.pointplot(data=df, dodge=True, join=False, ci='sd',
                      palette='muted',capsize=.1, errwidth =3,scale=2)
        x=[0,1,2]
        xt=['Ap Entropy' , 'Fuzzy Entropy', 'Sample Entropy']
        plt.yticks(fontsize = 18)
        plt.xticks(x,xt,fontsize=18)
        plt.ylabel('Entropy',fontsize = 22)

In [77]: jovenesHigh[['Persona','PendienteAp','PendienteFuzz', 'PendienteSamp']]

Out[77]:       Persona  PendienteAp  PendienteFuzz  PendienteSamp
         8       Edgar       0.2510         0.0030         0.2904
         9   enrique 1      -0.1658        -0.2365        -0.0078
         10  enrique 2      -0.0607        -0.1305         0.1797
         11  enrique 3      -0.4641        -0.2365        -0.6747
         12      Jardi       0.0066        -0.1232         0.3065
         14      Jorge      -0.0038         0.0560         0.0923

In [ ]:

In [ ]:

In [ ]:

In [ ]:

In [ ]:

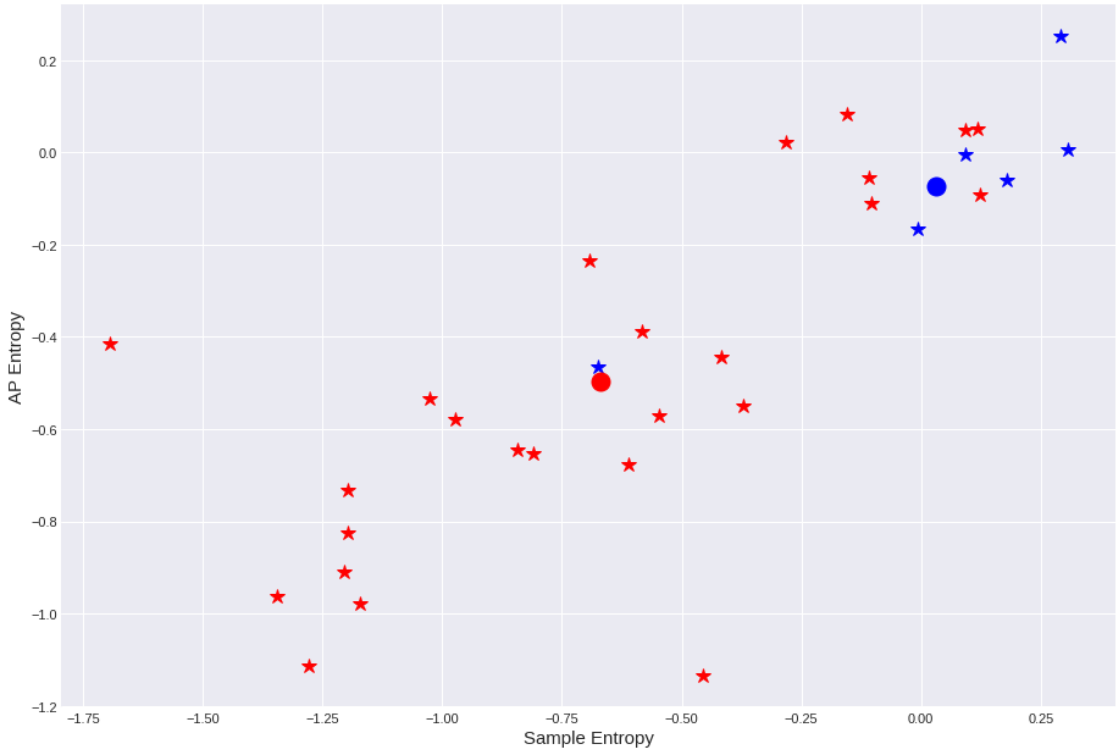
In [29]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])

         plt.style.use('seaborn-darkgrid')
         Act=jovenes[jovenes['Cuestionario']=='HIGH']
         Sed=jovenes[jovenes['Cuestionario']=='LOW']
         axes.plot(Act['PendienteSamp'],Act['PendienteAp'],'*',markersize=12,color='blue')

         axes.plot(Sed['PendienteSamp'],Sed['PendienteAp'],'*',markersize=12,color='red')
         axes.plot(Sed['PendienteSamp'].mean(),Sed['PendienteAp'].mean(),'o',markersize=15,colo
         axes.plot(Act['PendienteSamp'].mean(),Act['PendienteAp'].mean(),'o',markersize=15,colo

         plt.title('',fontsize=16)
         plt.xlabel('Sample Entropy',fontsize=15)
         plt.ylabel('AP Entropy',fontsize=15)
```

Out[29]: Text(0, 0.5, 'AP Entropy')



8 Gráficas de entropia vs entropia en pruebas de esfuerzo

In [30]:
```
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])

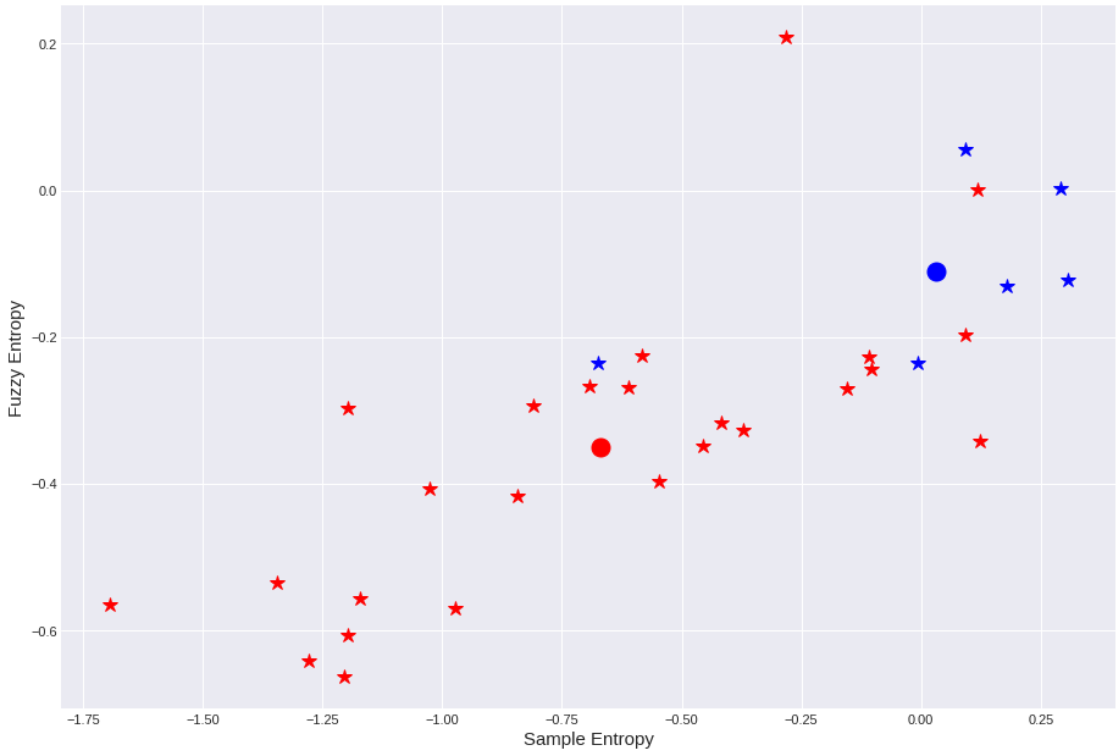
plt.style.use('seaborn-darkgrid')
Act=jovenes[jovenes['Cuestionario']=='HIGH']
Sed=jovenes[jovenes['Cuestionario']=='LOW']

axes.plot(Sed['PendienteSamp'],Sed['PendienteFuzz'],'*',markersize=12,color='red')
axes.plot(Act['PendienteSamp'],Act['PendienteFuzz'],'*',markersize=12,color='blue')

axes.plot(Sed['PendienteSamp'].mean(),Sed['PendienteFuzz'].mean(),'o',markersize=15,c
axes.plot(Act['PendienteSamp'].mean(),Act['PendienteFuzz'].mean(),'o',markersize=15,c


plt.title('',fontsize=16)
plt.xlabel('Sample Entropy',fontsize=15)
plt.ylabel('Fuzzy Entropy',fontsize=15)
```

Out[30]: Text(0, 0.5, 'Fuzzy Entropy')



In [31]:
```
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])

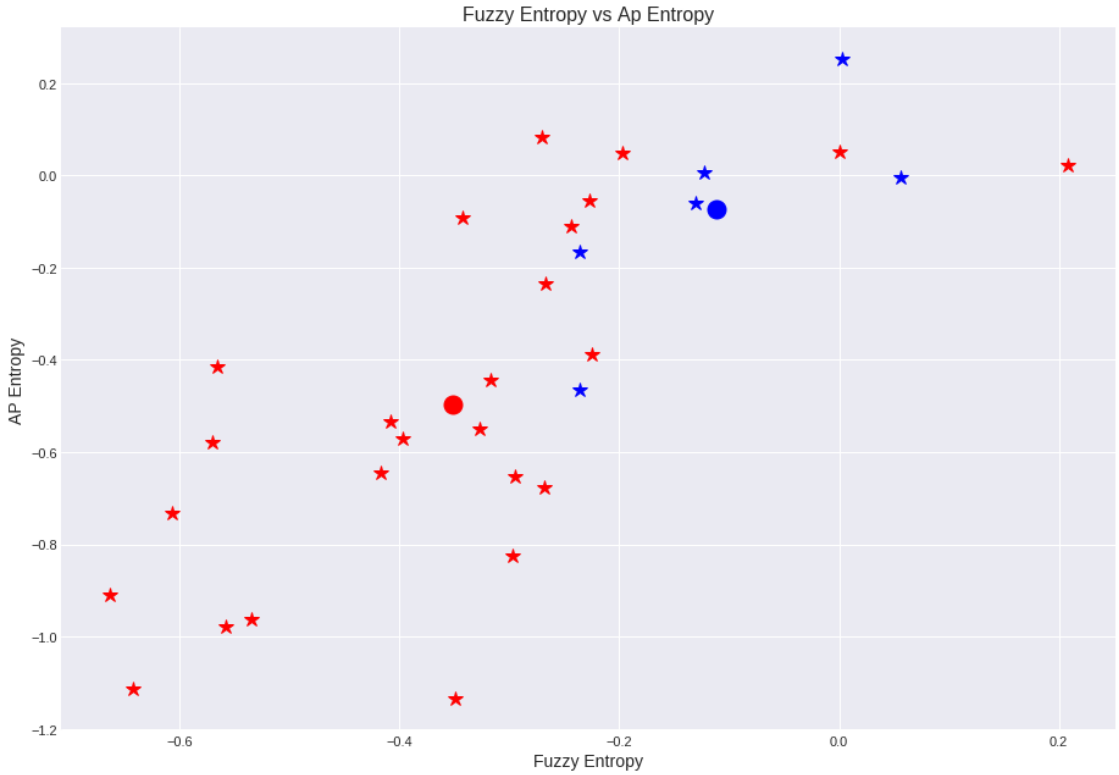
plt.style.use('seaborn-darkgrid')
Act=jovenes[jovenes['Cuestionario']=='HIGH']
Sed=jovenes[jovenes['Cuestionario']=='LOW']

axes.plot(Act['PendienteFuzz'],Act['PendienteAp'],'*',markersize=12,color='blue')
axes.plot(Sed['PendienteFuzz'],Sed['PendienteAp'],'*',markersize=12,color='red')

axes.plot(Act['PendienteFuzz'].mean(),Act['PendienteAp'].mean(),'o',markersize=15,colo
axes.plot(Sed['PendienteFuzz'].mean(),Sed['PendienteAp'].mean(),'o',markersize=15,colo


plt.title('Fuzzy Entropy vs Ap Entropy',fontsize=16)
plt.xlabel('Fuzzy Entropy',fontsize=14)
plt.ylabel('AP Entropy',fontsize=14)
```

Out[31]:
```
Text(0, 0.5, 'AP Entropy')
```



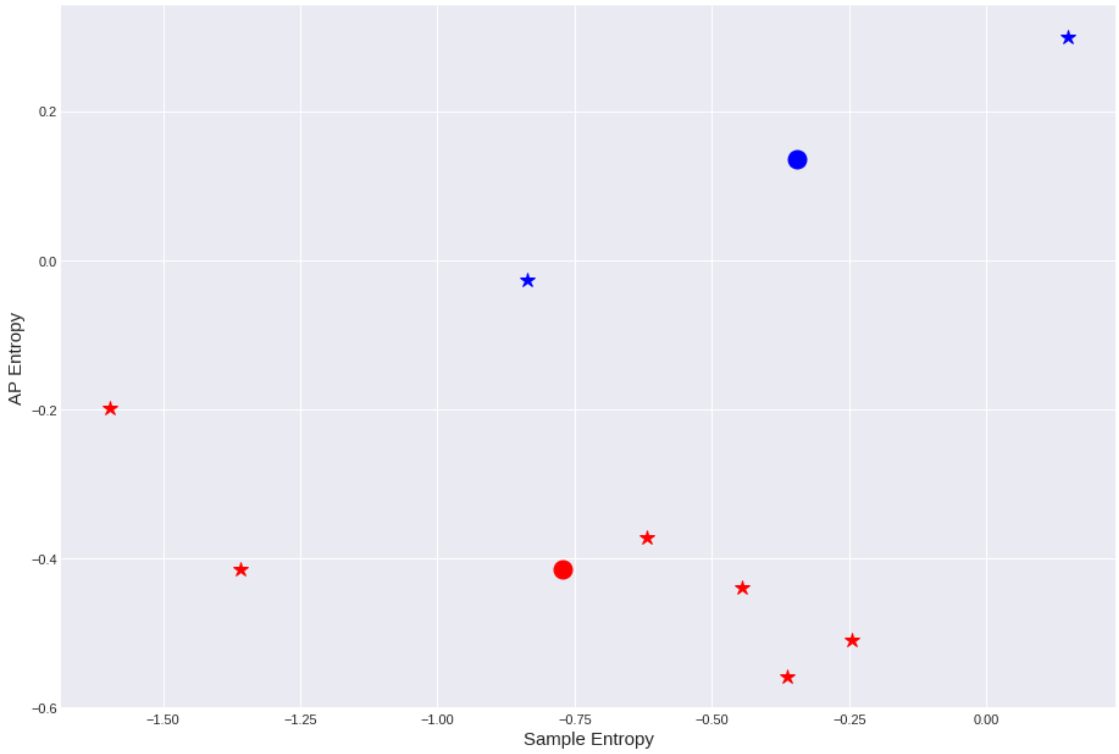

```
In [32]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])

         plt.style.use('seaborn-darkgrid')
         Act=adultos[adultos['Cuestionario']=='HIGH']
         Sed=adultos[adultos['Cuestionario']=='LOW']
         axes.plot(Act['PendienteSamp'],Act['PendienteAp'],'*',markersize=12,color='blue')

         axes.plot(Sed['PendienteSamp'],Sed['PendienteAp'],'*',markersize=12,color='red')
         axes.plot(Sed['PendienteSamp'].mean(),Sed['PendienteAp'].mean(),'o',markersize=15,colo
         axes.plot(Act['PendienteSamp'].mean(),Act['PendienteAp'].mean(),'o',markersize=15,colo

         plt.title('',fontsize=16)
         plt.xlabel('Sample Entropy',fontsize=15)
         plt.ylabel('AP Entropy',fontsize=15)

Out[32]: Text(0, 0.5, 'AP Entropy')
```




```
In [33]: Jlow= jovenesLow.copy()
         LowComplete= Jlow.append(adultos[adultos['Cuestionario']=='LOW'])
         # ActComplete


         Jact= jovenesHigh.copy()
         ActComplete= Jact.append(adultos[adultos['Cuestionario']=='HIGH'])
         # ActComplete
```

```
/home/eric/anaconda3/envs/tesina/lib/python3.7/site-packages/pandas/core/frame.py:6211: FutureW
of pandas will change to not sort by default.

To accept the future behavior, pass 'sort=False'.

To retain the current behavior and silence the warning, pass 'sort=True'.

  sort=sort)
```

```
In [34]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])

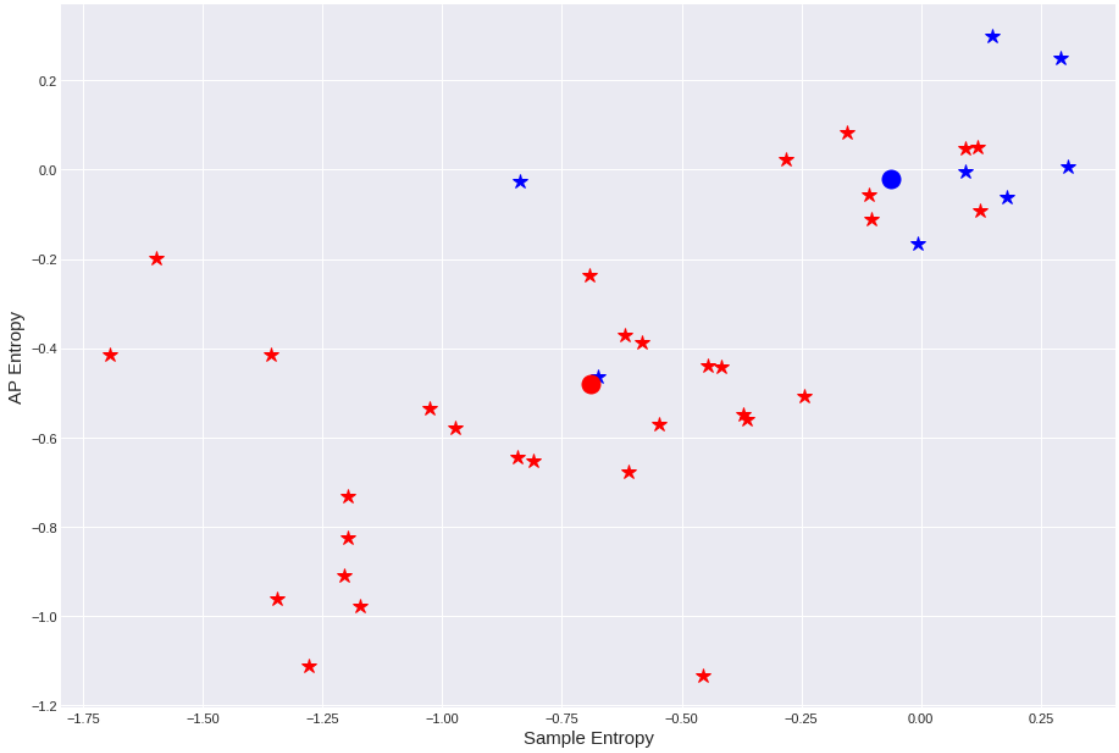
         plt.style.use('seaborn-darkgrid')
```

```
# Act=jovenes[jovenes['Cuestionario']=='HIGH']
# Sed=jovenes[jovenes['Cuestionario']=='LOW']
axes.plot(ActComplete['PendienteSamp'],ActComplete['PendienteAp'],'*',markersize=12,c

axes.plot(LowComplete['PendienteSamp'],LowComplete['PendienteAp'],'*',markersize=12,c
axes.plot(LowComplete['PendienteSamp'].mean(),LowComplete['PendienteAp'].mean(),'o',ma
axes.plot(ActComplete['PendienteSamp'].mean(),ActComplete['PendienteAp'].mean(),'o',ma

plt.title('',fontsize=16)
plt.xlabel('Sample Entropy',fontsize=15)
plt.ylabel('AP Entropy',fontsize=15)
```

Out[34]: Text(0, 0.5, 'AP Entropy')



In [35]:
```
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])

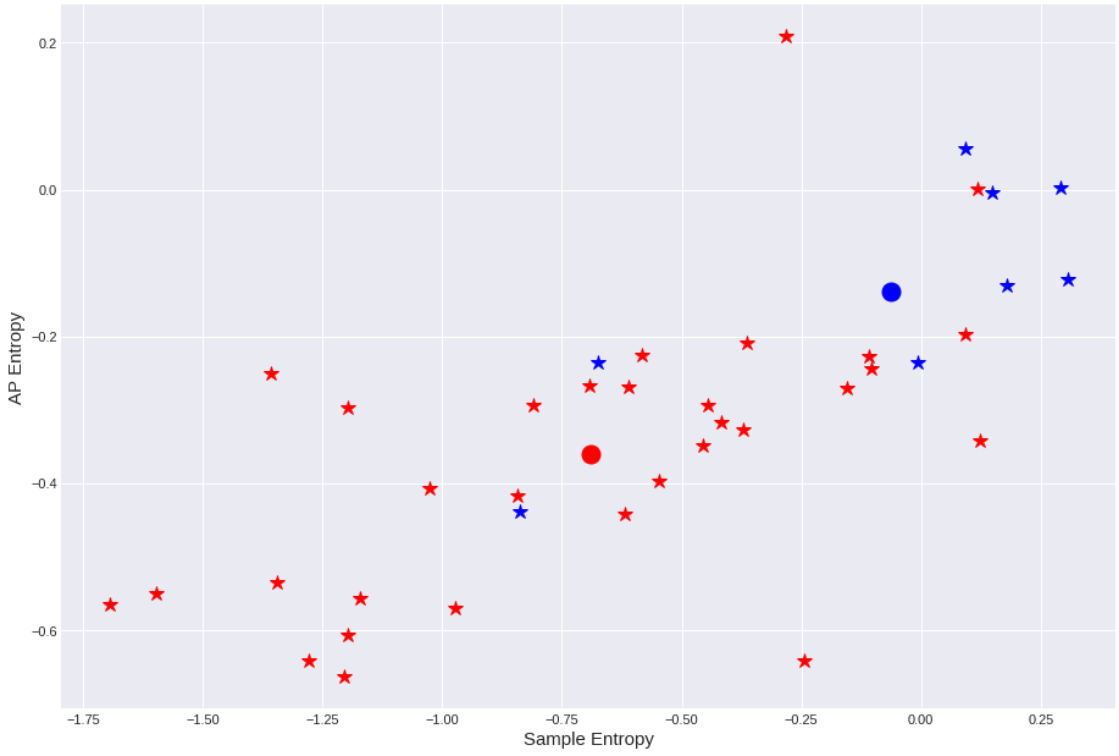
plt.style.use('seaborn-darkgrid')
# Act=jovenes[jovenes['Cuestionario']=='HIGH']
# Sed=jovenes[jovenes['Cuestionario']=='LOW']
axes.plot(ActComplete['PendienteSamp'],ActComplete['PendienteFuzz'],'*',markersize=12

axes.plot(LowComplete['PendienteSamp'],LowComplete['PendienteFuzz'],'*',markersize=12
```

```
axes.plot(LowComplete['PendienteSamp'].mean(),LowComplete['PendienteFuzz'].mean(),'o'
axes.plot(ActComplete['PendienteSamp'].mean(),ActComplete['PendienteFuzz'].mean(),'o'

plt.title('',fontsize=16)
plt.xlabel('Sample Entropy',fontsize=15)
plt.ylabel('AP Entropy',fontsize=15)
```

Out[35]: Text(0, 0.5, 'AP Entropy')



In [36]: jovenes.head()

Out[36]:

	Genero	Persona	Edad	Talla	Peso	IMC	Cuestionario	ReposoSamp	\
0	M	Amparo2	22	1.55	48.0	19.979188	LOW	1.2246	
1	M	Amparo3	22	1.55	48.0	19.979188	LOW	1.4239	
2	M	amparo4	22	1.55	48.0	19.979188	LOW	1.6778	
3	M	Amparo5	22	1.55	48.0	19.979188	LOW	1.2267	
4	M	Amparo6	22	1.55	48.0	19.979188	LOW	1.3495	

	3.5MPHSamp	4MPHSamp	...	4MPHAp	PendienteAp	AVGr	PNN50r	\
0	0.1814	0.6777	...	0.8773	-0.5719	0.827102	0.325513	
1	0.1370	0.145	...	0.1946	-1.1138	0.668367	0.156403	
2	1.9360	0.4804	...	0.5838	-0.7321	0.760648	0.281525	
3	1.8386	0.7719	...	0.6022	-1.1351	0.806219	0.291300	

```
4      0.8812   0.1772    ...      0.2620      -0.9780  0.684028  0.097952

     RMSSDr     SDNNr      AVGp    PNN50p    RMSSDp     SDNNp
0  0.055137  0.060082  0.400148  0.000000  0.006198  0.011765
1  0.039949  0.053411  0.447398  0.035191  0.121386  0.086467
2  0.048765  0.068671  0.522531  0.006843  0.054136  0.043902
3  0.057789  0.078291  0.428664  0.000000  0.006357  0.012745
4  0.030769  0.043573  0.469297  0.067449  0.141092  0.097246

[5 rows x 27 columns]
```

9 Variabilidad Cardiaca

9.1 AVGr

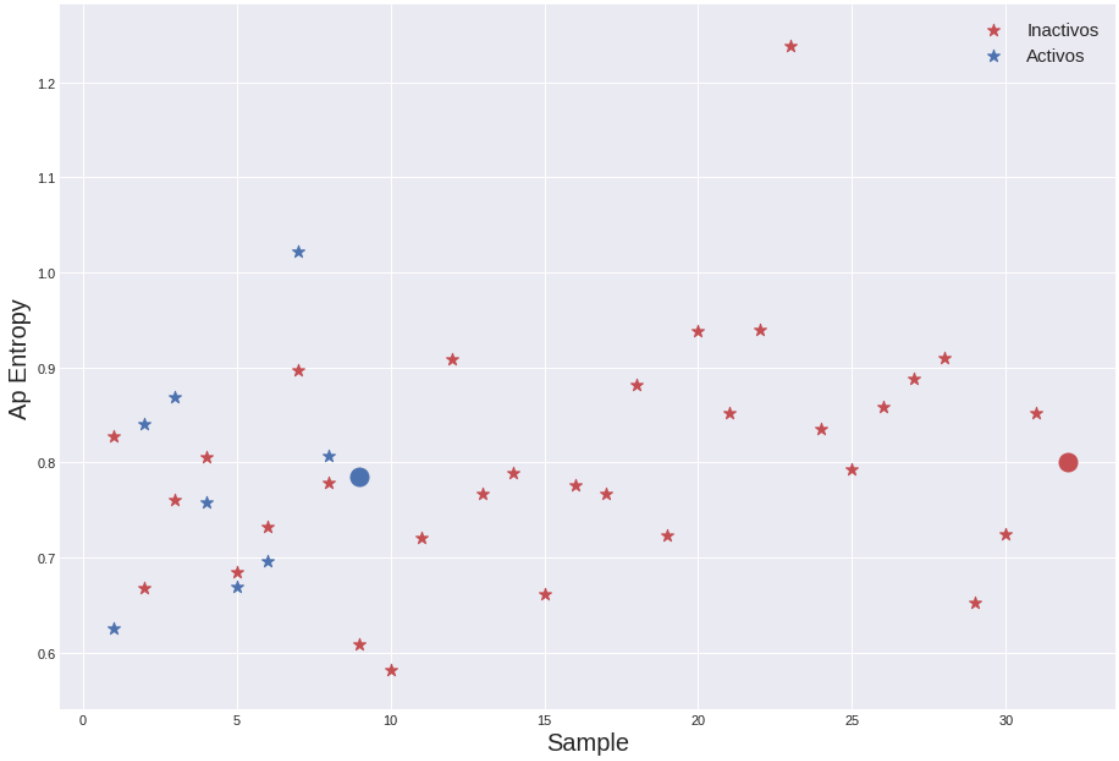
In [37]:
```
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])

plt.style.use('seaborn-darkgrid')
axes.scatter(np.arange(1,len(LowComplete)+1),LowComplete['AVGr'],c='r',marker='*',s=1
axes.scatter(np.arange(1,len(ActComplete)+1),ActComplete['AVGr'],c='b',marker='*',s=1

plt.legend(['Inactivos','Activos'],fontsize=15)
plt.xlabel('Sample',fontsize=20)
plt.ylabel('Ap Entropy',fontsize=20)

axes.plot(len(LowComplete)+1,np.mean(LowComplete['AVGr']),c='r',marker='o',markersize=
axes.plot(len(ActComplete)+1,np.mean(ActComplete['AVGr']),c='b',marker='o',markersize=
```

Out[37]:
```
[<matplotlib.lines.Line2D at 0x7fbbf1fb4d68>]
```



9.2 PNN50r

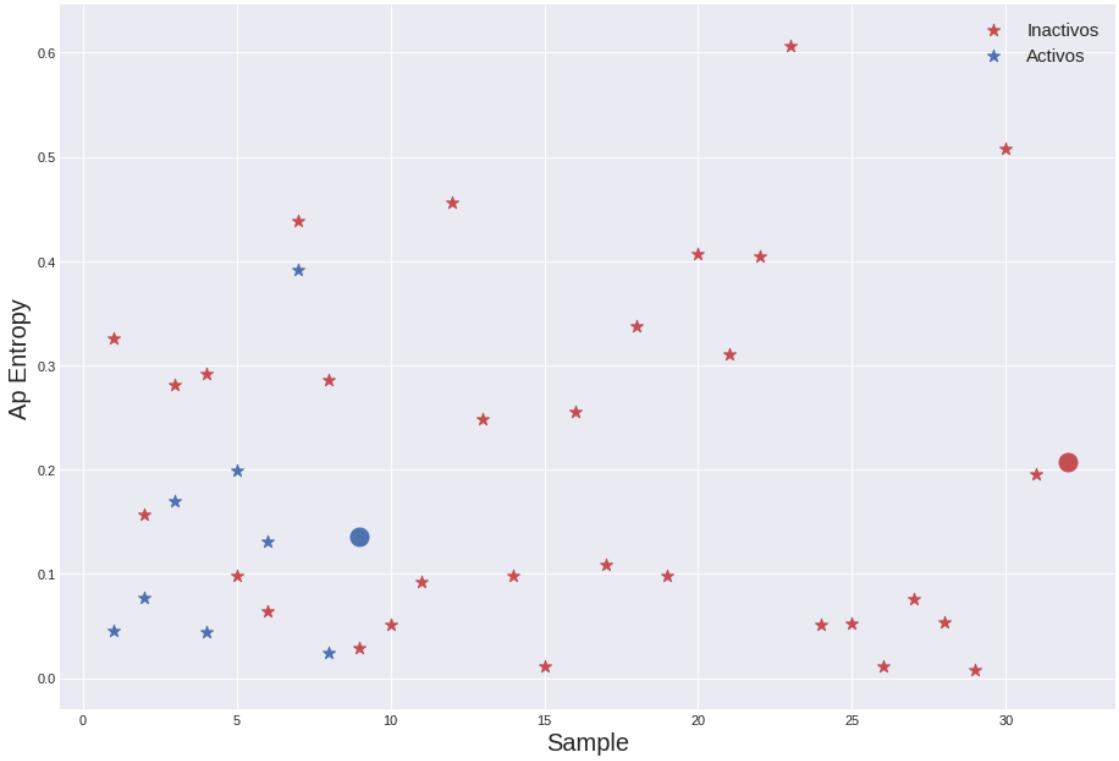
```
In [38]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])

         plt.style.use('seaborn-darkgrid')
         axes.scatter(np.arange(1,len(LowComplete)+1),LowComplete['PNN50r'],c='r',marker='*',s=
         axes.scatter(np.arange(1,len(ActComplete)+1),ActComplete['PNN50r'],c='b',marker='*',s=

         plt.legend(['Inactivos','Activos'],fontsize=15)
         plt.xlabel('Sample',fontsize=20)
         plt.ylabel('Ap Entropy',fontsize=20)

         axes.plot(len(LowComplete)+1,np.mean(LowComplete['PNN50r']),c='r',marker='o',markersiz
         axes.plot(len(ActComplete)+1,np.mean(ActComplete['PNN50r']),c='b',marker='o',markersiz

Out[38]: [<matplotlib.lines.Line2D at 0x7fbbf1f1eeb8>]
```



9.3 RMSSDr

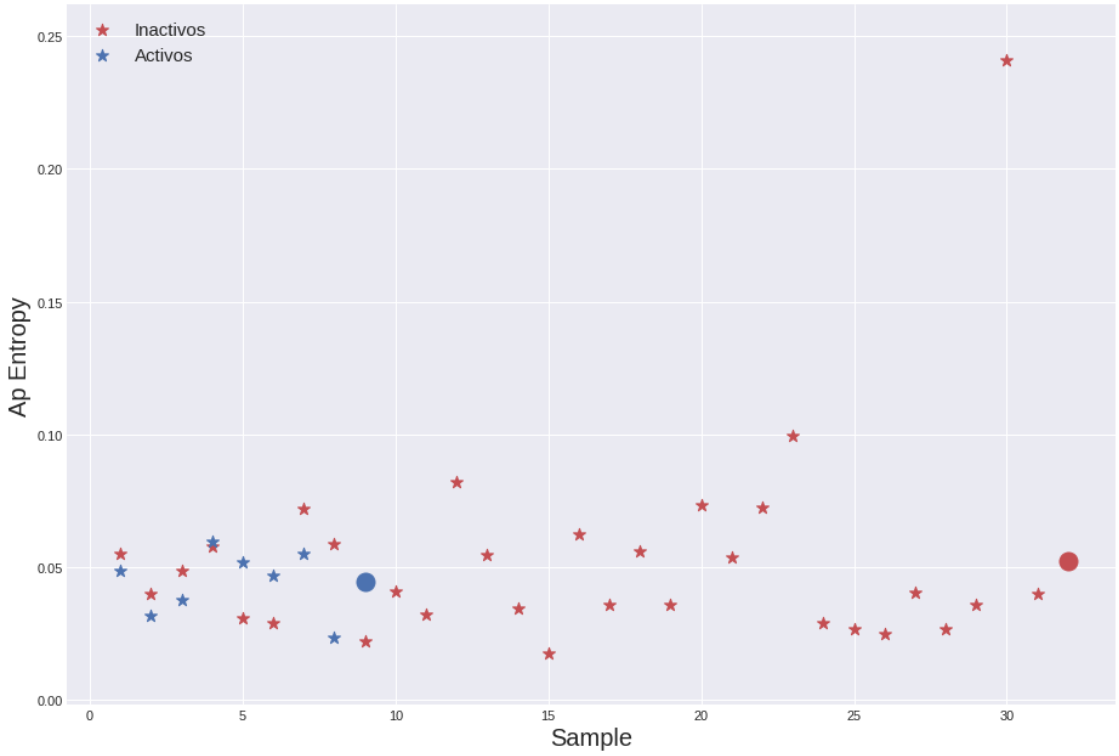
```
In [39]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])

         plt.style.use('seaborn-darkgrid')
         axes.scatter(np.arange(1,len(LowComplete)+1),LowComplete['RMSSDr'],c='r',marker='*',s=
         axes.scatter(np.arange(1,len(ActComplete)+1),ActComplete['RMSSDr'],c='b',marker='*',s=

         plt.legend(['Inactivos','Activos'],fontsize=15)
         plt.xlabel('Sample',fontsize=20)
         plt.ylabel('Ap Entropy',fontsize=20)

         axes.plot(len(LowComplete)+1,np.mean(LowComplete['RMSSDr']),c='r',marker='o',markersiz
         axes.plot(len(ActComplete)+1,np.mean(ActComplete['RMSSDr']),c='b',marker='o',markersiz

Out[39]: [<matplotlib.lines.Line2D at 0x7fbbf1f08d68>]
```



9.4 SDNNr

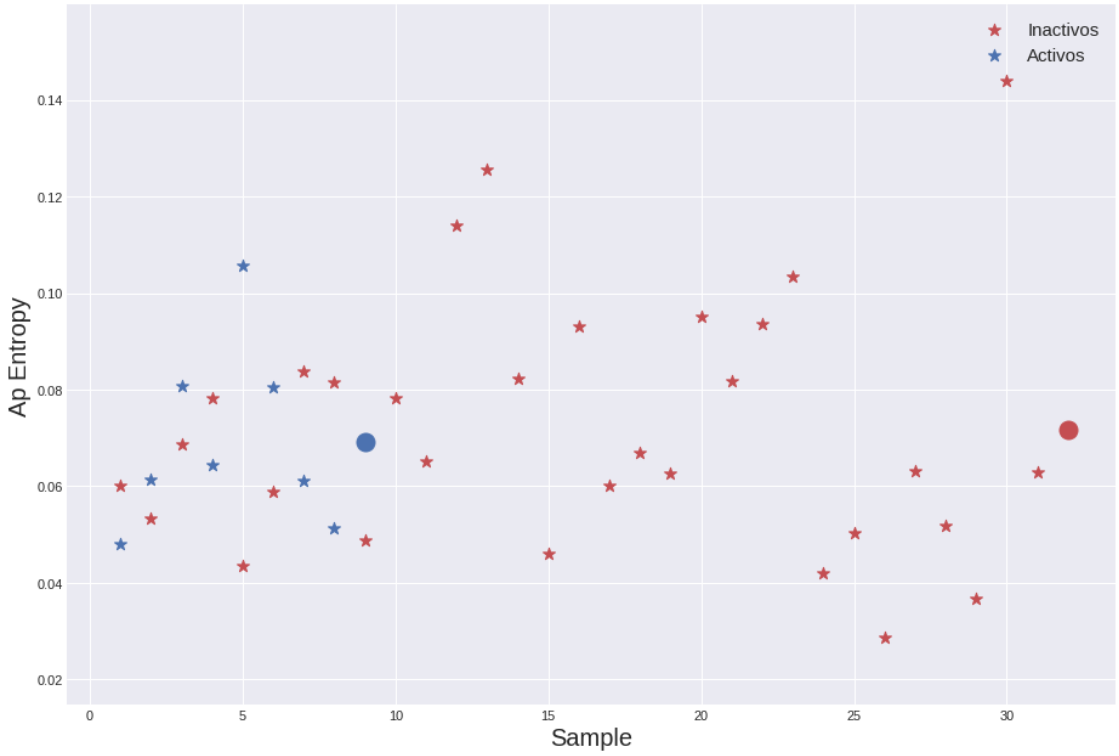
```
In [40]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])

         plt.style.use('seaborn-darkgrid')
         axes.scatter(np.arange(1,len(LowComplete)+1),LowComplete['SDNNr'],c='r',marker='*',s=
         axes.scatter(np.arange(1,len(ActComplete)+1),ActComplete['SDNNr'],c='b',marker='*',s=

         plt.legend(['Inactivos','Activos'],fontsize=15)
         plt.xlabel('Sample',fontsize=20)
         plt.ylabel('Ap Entropy',fontsize=20)

         axes.plot(len(LowComplete)+1,np.mean(LowComplete['SDNNr']),c='r',marker='o',markersize
         axes.plot(len(ActComplete)+1,np.mean(ActComplete['SDNNr']),c='b',marker='o',markersize

Out[40]: [<matplotlib.lines.Line2D at 0x7fbbf1e6feb8>]
```



9.5 AVGp

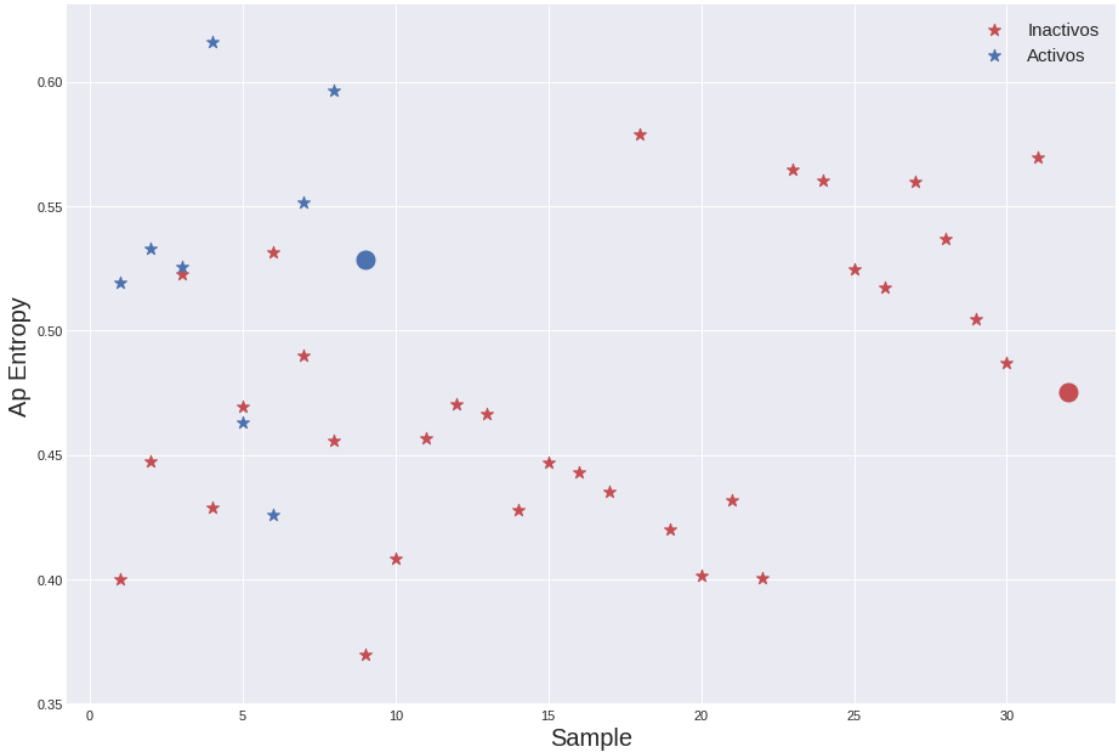
```
In [41]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])

         plt.style.use('seaborn-darkgrid')
         axes.scatter(np.arange(1,len(LowComplete)+1),LowComplete['AVGp'],c='r',marker='*',s=1
         axes.scatter(np.arange(1,len(ActComplete)+1),ActComplete['AVGp'],c='b',marker='*',s=1

         plt.legend(['Inactivos','Activos'],fontsize=15)
         plt.xlabel('Sample',fontsize=20)
         plt.ylabel('Ap Entropy',fontsize=20)

         axes.plot(len(LowComplete)+1,np.mean(LowComplete['AVGp']),c='r',marker='o',markersize=
         axes.plot(len(ActComplete)+1,np.mean(ActComplete['AVGp']),c='b',marker='o',markersize=

Out[41]: [<matplotlib.lines.Line2D at 0x7fbbf1ddfef0>]
```



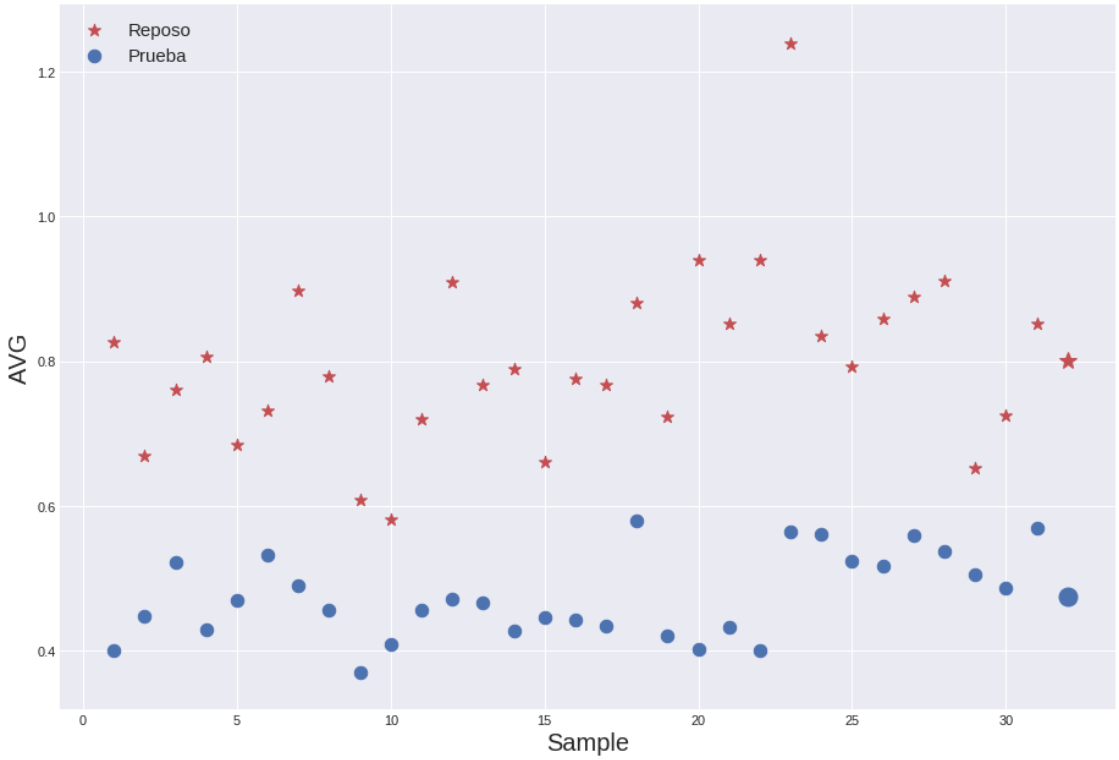

```
In [42]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])

         plt.style.use('seaborn-darkgrid')
         axes.scatter(np.arange(1,len(LowComplete)+1),LowComplete['AVGr'],c='r',marker='*',s=1
         axes.scatter(np.arange(1,len(LowComplete)+1),LowComplete['AVGp'],c='b',marker='o',s=1

         plt.legend(['Reposo','Prueba'],fontsize=15,loc='upper left')
         plt.xlabel('Sample',fontsize=20)
         plt.ylabel('AVG',fontsize=20)

         axes.plot(len(LowComplete)+1,np.mean(LowComplete['AVGr']),c='r',marker='*',markersize=
         axes.plot(len(LowComplete)+1,np.mean(LowComplete['AVGp']),c='b',marker='o',markersize=

Out[42]: [<matplotlib.lines.Line2D at 0x7fbbf1dcc8d0>]
```



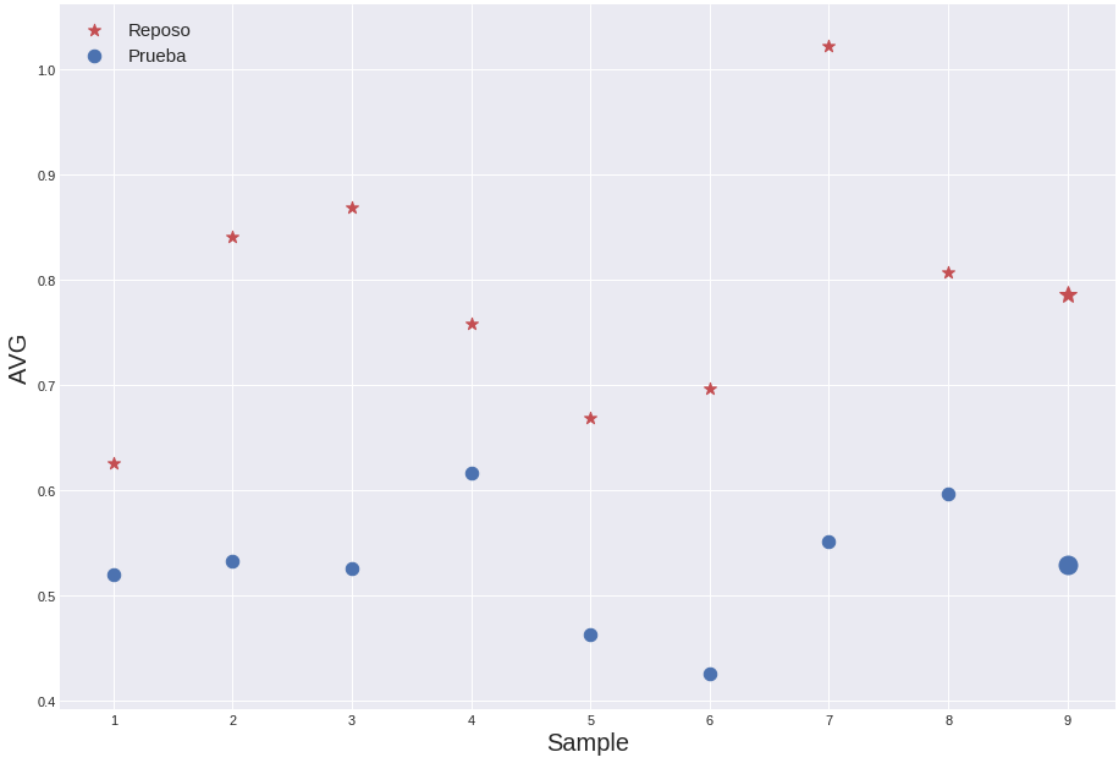

```
In [43]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])

         plt.style.use('seaborn-darkgrid')
         axes.scatter(np.arange(1,len(ActComplete)+1),ActComplete['AVGr'],c='r',marker='*',s=1
         axes.scatter(np.arange(1,len(ActComplete)+1),ActComplete['AVGp'],c='b',marker='o',s=1

         plt.legend(['Reposo','Prueba'],fontsize=15,loc='upper left')
         plt.xlabel('Sample',fontsize=20)
         plt.ylabel('AVG',fontsize=20)

         axes.plot(len(ActComplete)+1,np.mean(ActComplete['AVGr']),c='r',marker='*',markersize
         axes.plot(len(ActComplete)+1,np.mean(ActComplete['AVGp']),c='b',marker='o',markersize

Out[43]: [<matplotlib.lines.Line2D at 0x7fbbf1d31ef0>]
```



In [ ]:

9.6 PNN50p

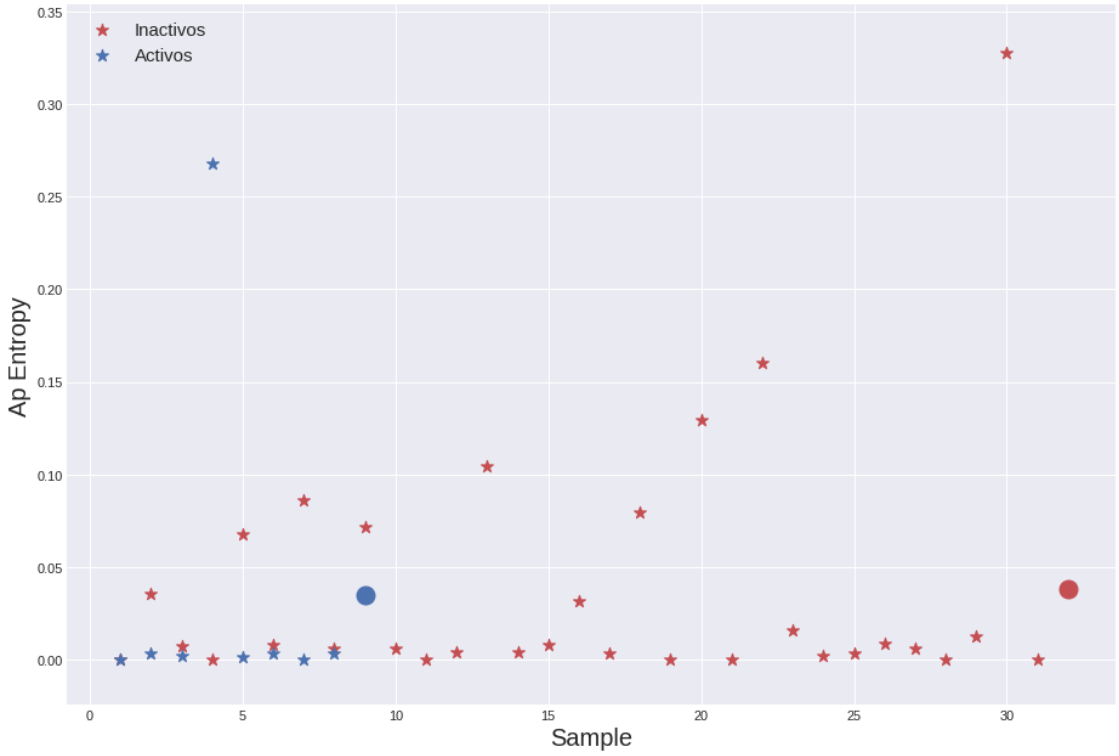
```
In [44]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])

         plt.style.use('seaborn-darkgrid')
         axes.scatter(np.arange(1,len(LowComplete)+1),LowComplete['PNN50p'],c='r',marker='*',s=
         axes.scatter(np.arange(1,len(ActComplete)+1),ActComplete['PNN50p'],c='b',marker='*',s=

         plt.legend(['Inactivos','Activos'],fontsize=15)
         plt.xlabel('Sample',fontsize=20)
         plt.ylabel('Ap Entropy',fontsize=20)

         axes.plot(len(LowComplete)+1,np.mean(LowComplete['PNN50p']),c='r',marker='o',markersiz
         axes.plot(len(ActComplete)+1,np.mean(ActComplete['PNN50p']),c='b',marker='o',markersiz

Out[44]: [<matplotlib.lines.Line2D at 0x7fbbf1caed30>]
```



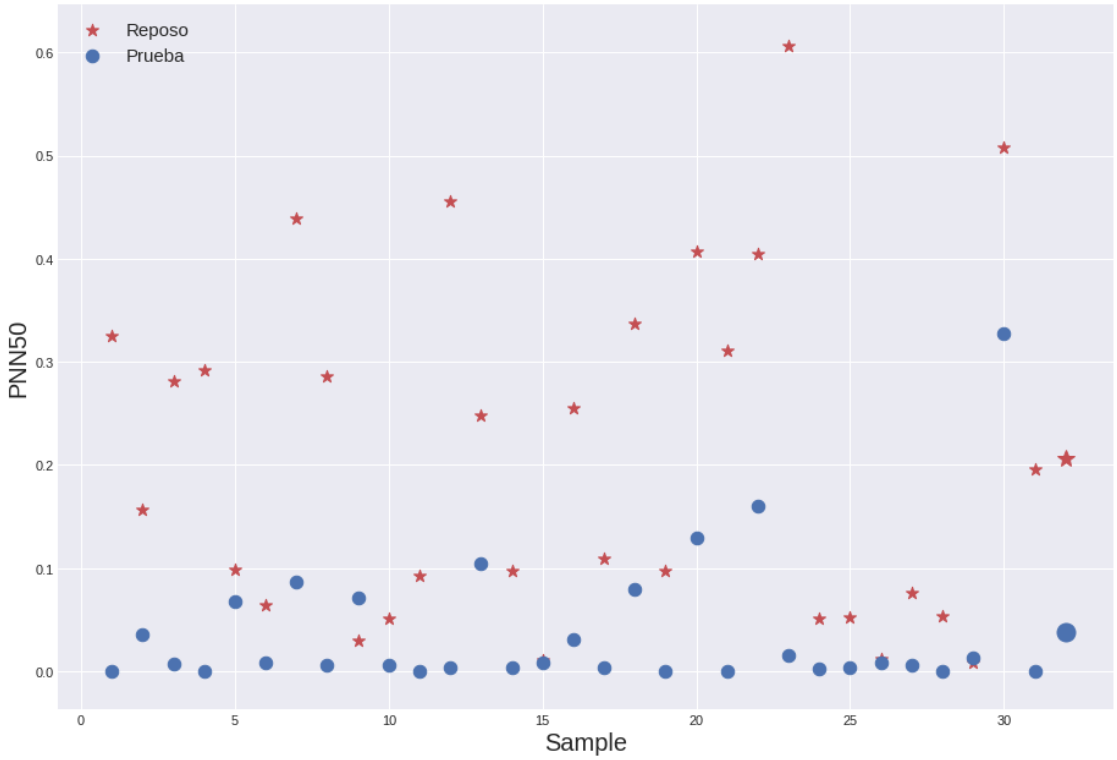
In [45]:
```
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])

plt.style.use('seaborn-darkgrid')
axes.scatter(np.arange(1,len(LowComplete)+1),LowComplete['PNN50r'],c='r',marker='*',s=
axes.scatter(np.arange(1,len(LowComplete)+1),LowComplete['PNN50p'],c='b',marker='o',s=

plt.legend(['Reposo','Prueba'],fontsize=15,loc='upper left')
plt.xlabel('Sample',fontsize=20)
plt.ylabel('PNN50',fontsize=20)

axes.plot(len(LowComplete)+1,np.mean(LowComplete['PNN50r']),c='r',marker='*',markersiz
axes.plot(len(LowComplete)+1,np.mean(LowComplete['PNN50p']),c='b',marker='o',markersiz
```

Out[45]:
```
[<matplotlib.lines.Line2D at 0x7fbbf1c1e940>]
```



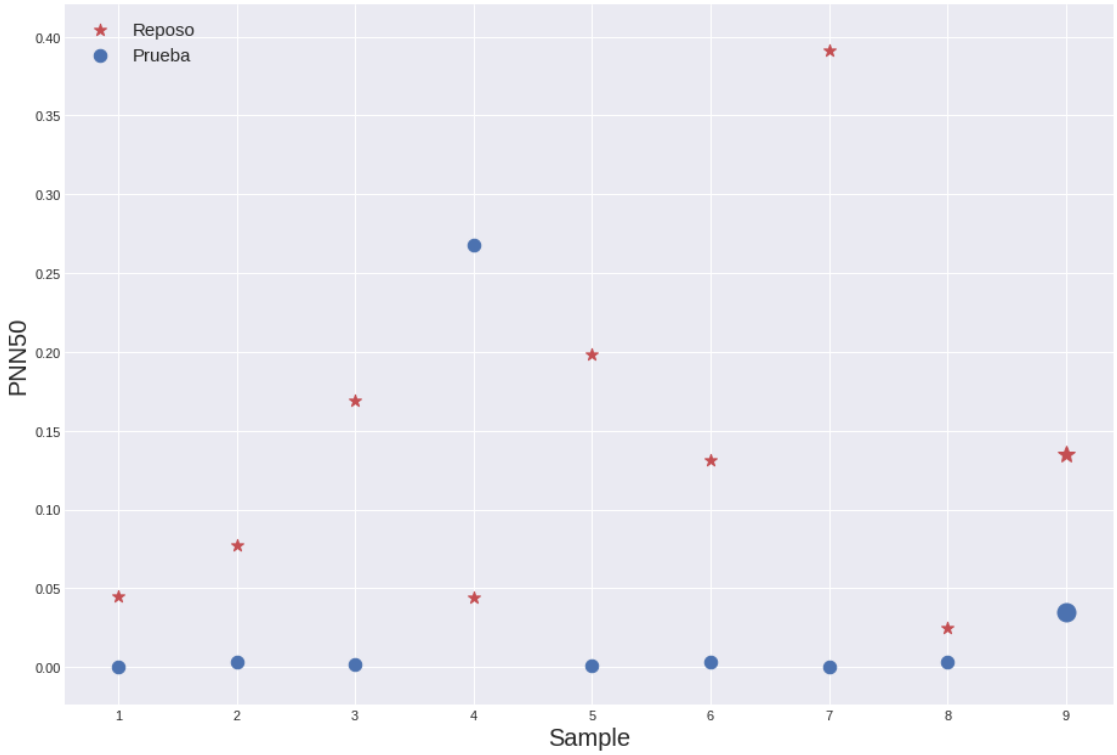

```
In [46]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])

         plt.style.use('seaborn-darkgrid')
         axes.scatter(np.arange(1,len(ActComplete)+1),ActComplete['PNN50r'],c='r',marker='*',s=
         axes.scatter(np.arange(1,len(ActComplete)+1),ActComplete['PNN50p'],c='b',marker='o',s=

         plt.legend(['Reposo','Prueba'],fontsize=15,loc='upper left')
         plt.xlabel('Sample',fontsize=20)
         plt.ylabel('PNN50',fontsize=20)

         axes.plot(len(ActComplete)+1,np.mean(ActComplete['PNN50r']),c='r',marker='*',markersiz
         axes.plot(len(ActComplete)+1,np.mean(ActComplete['PNN50p']),c='b',marker='o',markersiz

Out[46]: [<matplotlib.lines.Line2D at 0x7fbbf1c0d978>]
```



In [ ]:

9.7 RMSSDp

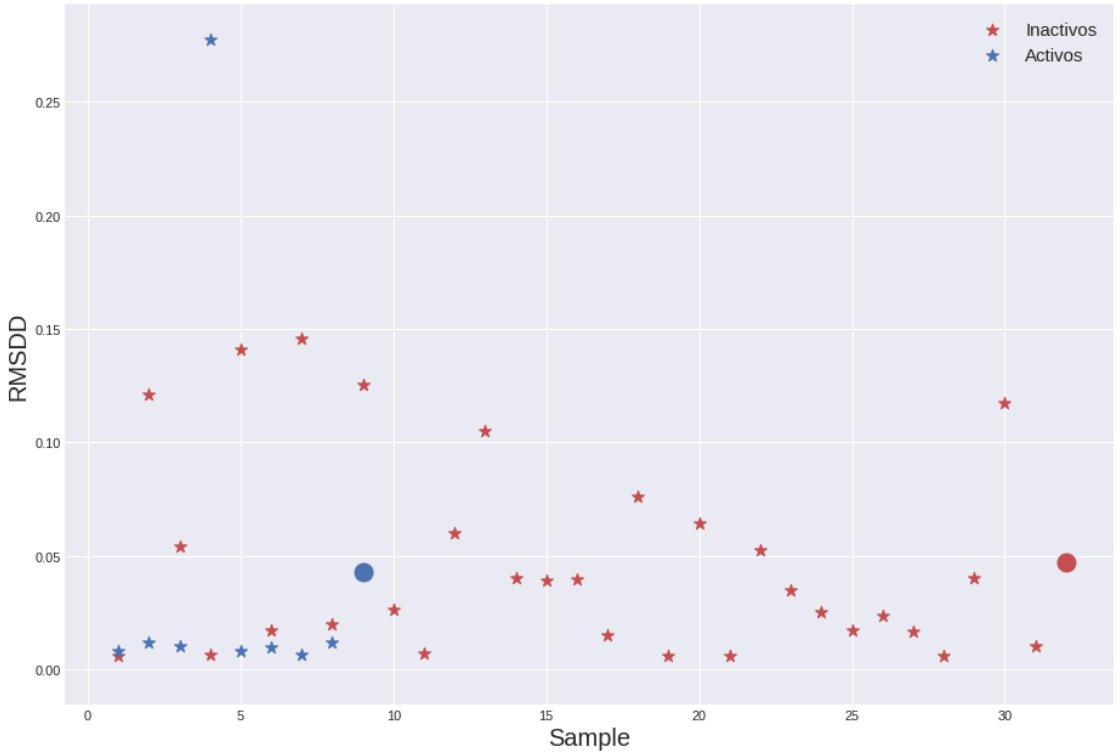
In [47]:
```
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])

plt.style.use('seaborn-darkgrid')
axes.scatter(np.arange(1,len(LowComplete)+1),LowComplete['RMSSDp'],c='r',marker='*',s=
axes.scatter(np.arange(1,len(ActComplete)+1),ActComplete['RMSSDp'],c='b',marker='*',s=

plt.legend(['Inactivos','Activos'],fontsize=15)
plt.xlabel('Sample',fontsize=20)
plt.ylabel('RMSDD',fontsize=20)

axes.plot(len(LowComplete)+1,np.mean(LowComplete['RMSSDp']),c='r',marker='o',markersiz
axes.plot(len(ActComplete)+1,np.mean(ActComplete['RMSSDp']),c='b',marker='o',markersiz
```

Out[47]: [<matplotlib.lines.Line2D at 0x7fbbf1b8af60>]



In [ ]:

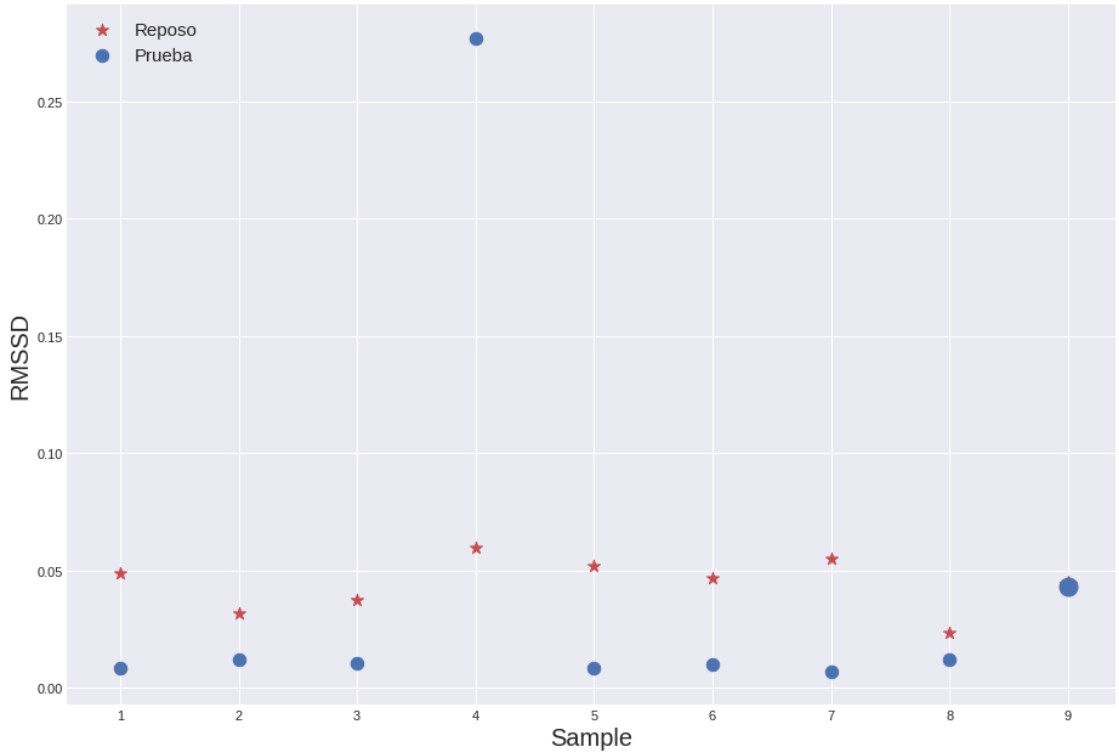
In [48]:
```
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])

plt.style.use('seaborn-darkgrid')
axes.scatter(np.arange(1,len(ActComplete)+1),ActComplete['RMSSDr'],c='r',marker='*',s=
axes.scatter(np.arange(1,len(ActComplete)+1),ActComplete['RMSSDp'],c='b',marker='o',s=

plt.legend(['Reposo','Prueba'],fontsize=15,loc='upper left')
plt.xlabel('Sample',fontsize=20)
plt.ylabel('RMSSD',fontsize=20)

axes.plot(len(ActComplete)+1,np.mean(ActComplete['RMSSDr']),c='r',marker='*',markersiz
axes.plot(len(ActComplete)+1,np.mean(ActComplete['RMSSDp']),c='b',marker='o',markersiz
```

Out[48]: [<matplotlib.lines.Line2D at 0x7fbbf1af49e8>]



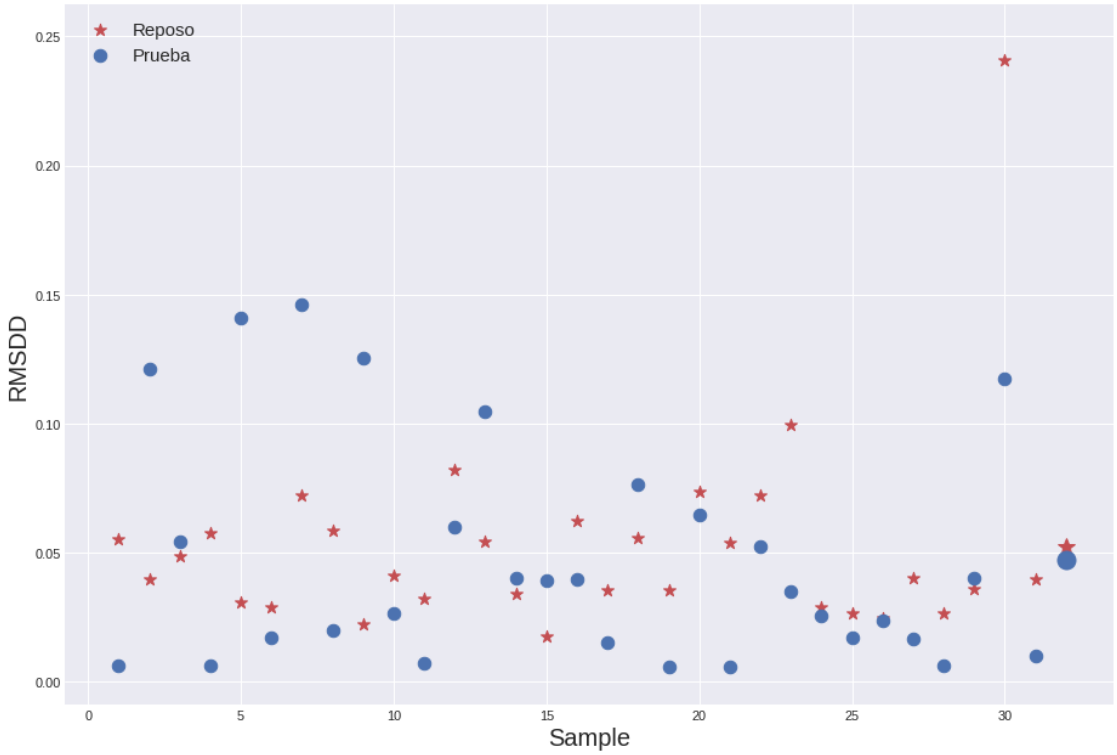
In [49]:
```
fig=plt.figure()
axes=fig.add_axes([0.1,0.1,2,2])

plt.style.use('seaborn-darkgrid')
axes.scatter(np.arange(1,len(LowComplete)+1),LowComplete['RMSSDr'],c='r',marker='*',s=
axes.scatter(np.arange(1,len(LowComplete)+1),LowComplete['RMSSDp'],c='b',marker='o',s=

plt.legend(['Reposo','Prueba'],fontsize=15,loc='upper left')
plt.xlabel('Sample',fontsize=20)
plt.ylabel('RMSDD',fontsize=20)

axes.plot(len(LowComplete)+1,np.mean(LowComplete['RMSSDr']),c='r',marker='*',markersiz
axes.plot(len(LowComplete)+1,np.mean(LowComplete['RMSSDp']),c='b',marker='o',markersiz
```

Out[49]:
```
[<matplotlib.lines.Line2D at 0x7fbbf1a60d68>]
```



9.8 SDNNp

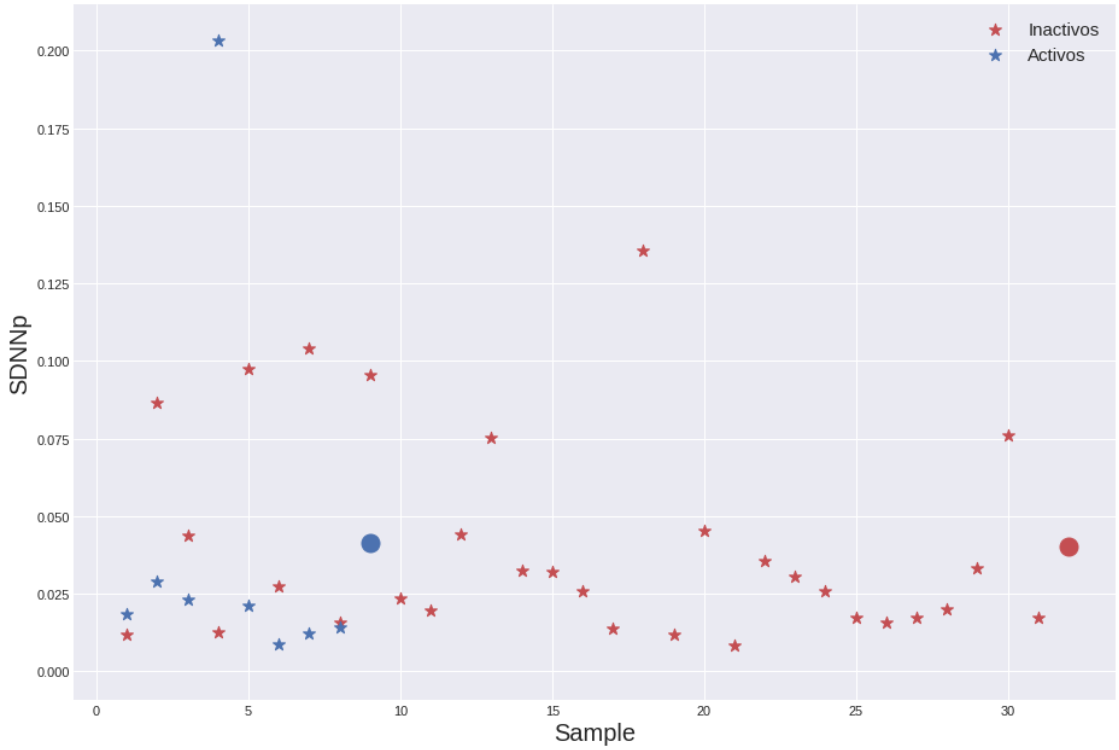
```
In [50]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])

         plt.style.use('seaborn-darkgrid')
         axes.scatter(np.arange(1,len(LowComplete)+1),LowComplete['SDNNp'],c='r',marker='*',s=
         axes.scatter(np.arange(1,len(ActComplete)+1),ActComplete['SDNNp'],c='b',marker='*',s=

         plt.legend(['Inactivos','Activos'],fontsize=15)
         plt.xlabel('Sample',fontsize=20)
         plt.ylabel('SDNNp',fontsize=20)

         axes.plot(len(LowComplete)+1,np.mean(LowComplete['SDNNp']),c='r',marker='o',markersize
         axes.plot(len(ActComplete)+1,np.mean(ActComplete['SDNNp']),c='b',marker='o',markersize

Out[50]: [<matplotlib.lines.Line2D at 0x7fbbf1a3ecc0>]
```



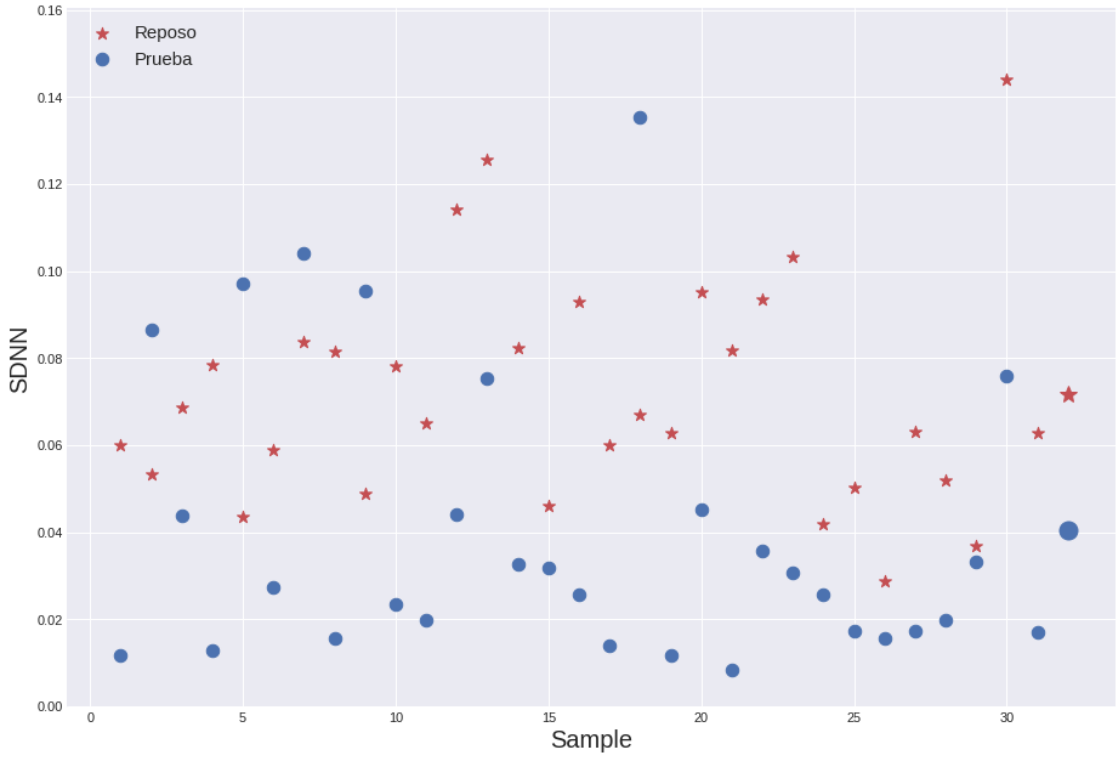

```
In [51]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])

         plt.style.use('seaborn-darkgrid')
         axes.scatter(np.arange(1,len(LowComplete)+1),LowComplete['SDNNr'],c='r',marker='*',s=
         axes.scatter(np.arange(1,len(LowComplete)+1),LowComplete['SDNNp'],c='b',marker='o',s=

         plt.legend(['Reposo','Prueba'],fontsize=15,loc='upper left')
         plt.xlabel('Sample',fontsize=20)
         plt.ylabel('SDNN',fontsize=20)

         axes.plot(len(LowComplete)+1,np.mean(LowComplete['SDNNr']),c='r',marker='*',markersize
         axes.plot(len(LowComplete)+1,np.mean(LowComplete['SDNNp']),c='b',marker='o',markersize

Out[51]: [<matplotlib.lines.Line2D at 0x7fbbf19b3cf8>]
```



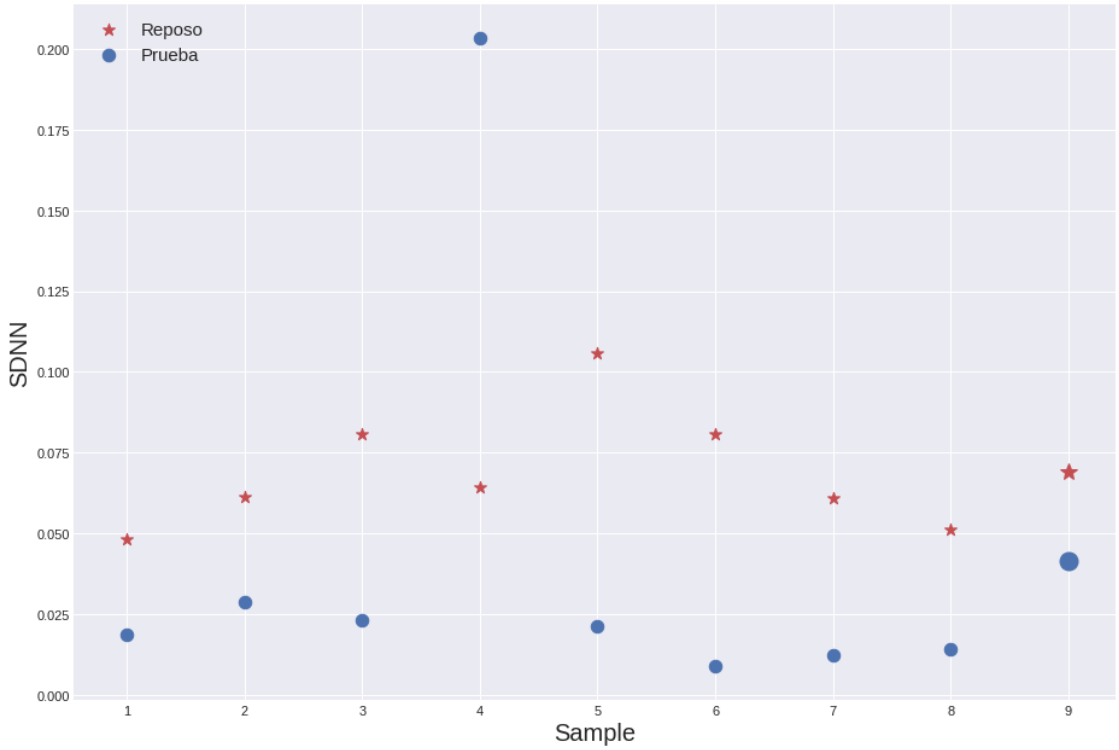

```
In [52]: fig=plt.figure()
         axes=fig.add_axes([0.1,0.1,2,2])

         plt.style.use('seaborn-darkgrid')
         axes.scatter(np.arange(1,len(ActComplete)+1),ActComplete['SDNNr'],c='r',marker='*',s=
         axes.scatter(np.arange(1,len(ActComplete)+1),ActComplete['SDNNp'],c='b',marker='o',s=

         plt.legend(['Reposo','Prueba'],fontsize=15,loc='upper left')
         plt.xlabel('Sample',fontsize=20)
         plt.ylabel('SDNN',fontsize=20)

         axes.plot(len(ActComplete)+1,np.mean(ActComplete['SDNNr']),c='r',marker='*',markersize
         axes.plot(len(ActComplete)+1,np.mean(ActComplete['SDNNp']),c='b',marker='o',markersize

Out[52]: [<matplotlib.lines.Line2D at 0x7fbbf191ccf8>]
```



In [ ]:

10 Statistical tests

We can use this test, if we observe two independent samples from the same or different population, e.g. exam scores of boys and girls or of two ethnic groups. The test measures whether the average (expected) value differs significantly across samples. If we observe a large p-value, for example larger than 0.05 or 0.1, then we cannot reject the null hypothesis of identical average scores. If the p-value is smaller than the threshold, e.g. 1%, 5% or 10%, then we reject the null hypothesis of equal averages.

In [53]:
```
## Import the packages
from scipy import stats


## Define 2 random distributions
#Sample Size
N = 10
#Gaussian distributed data with mean = 2 and var = 1
a = np.random.randn(N) + 2
#Gaussian distributed data with with mean = 0 and var = 1
b = np.random.randn(N)
```

```
        ## Calculate the Standard Deviation
        #Calculate the variance to get the standard deviation

        #For unbiased max likelihood estimate we have to divide the var by N-1, and therefore
        var_a = a.var(ddof=1)
        var_b = b.var(ddof=1)

        #std deviation
        s = np.sqrt((var_a + var_b)/2)
        print('Standard deviation ',s)



        ## Calculate the t-statistics
        t = (a.mean() - b.mean())/(s*np.sqrt(2/N))



        ## Compare with the critical t-value
        #Degrees of freedom
        df = 2*N - 2

        #p-value after comparison with the t
        p = 1 - stats.t.cdf(t,df=df)


        print("t = " + str(t))
        print("p = " + str(2*p))
        ### You can see that after comparing the t statistic with the critical t value (compu


        ## Cross Checking with the internal scipy function
        t2, p2 = stats.ttest_ind(a,b)
        print("t = " + str(t2))
        print("p = " + str(p2))
```

```
Standard deviation  0.879864895767739
t = 3.740222475313658
p = 0.0014982270398680164
t = 3.740222475313658
p = 0.0014982270398680633
```

In [ ]:

11 Pruebas Estadisticas para Physionet

H_0 = No existe una diferencia significativa entre ambas medias
H_1 = Existe una diferencia significativa entre ambas medias.

11.0.1 Ap Entropy Dormidos

```
In [52]: dormidosCHF1=np.array(dormidosCHF['ApEntropy'].dropna() )
         dormidosH1=np.array(dormidosH['ApEntropy'].dropna())

In [53]: tDormidos, pDormidos = stats.ttest_ind(dormidosCHF1,dormidosH1)

In [54]: print(tDormidos,pDormidos)

-4.0481519158977415 0.00011074175576521039
```

El valor de p=0.000110741 es menor que el intervalo de confianza $\alpha = 0.05$ por lo tanto se rechaza H_0 y se acepta H_1, siendo así la diferencia entre las medias significativa.

11.0.2 Sample Entropy Dormidos

```
In [55]: dormidosCHF1=np.array(dormidosCHF['SampleEntropy'].dropna() )
         dormidosH1=np.array(dormidosH['SampleEntropy'].dropna())

In [56]: tDormidos, pDormidos = stats.ttest_ind(dormidosCHF1,dormidosH1)

In [57]: print(tDormidos,pDormidos)

-3.5199829608621718 0.0006825922818150329
```

El valor de p=0.00068259 es menor que el intervalo de confianza $\alpha = 0.05$ por lo tanto se rechaza H_0 y se acepta H_1, siendo así la diferencia entre las medias significativa.

11.0.3 Fuzzy entropy

```
In [58]: dormidosCHF1=np.array(dormidosCHF['FuzzyEntropy'].dropna() )
         dormidosH1=np.array(dormidosH['FuzzyEntropy'].dropna())

In [59]: tDormidos, pDormidos = stats.ttest_ind(dormidosCHF1,dormidosH1)

In [60]: print(tDormidos,pDormidos)

-3.8795108306023325 0.00020160582312409614
```

El valor de p=0.000201 es menor que el intervalo de confianza $\alpha = 0.05$ por lo tanto se rechaza H_0 y se acepta H_1, siendo así la diferencia entre las medias significativa

12 Pruebas Estadísticas para pruebas de esfuerzo

Para estas pruebas se tienen 31 jovenes, de los cuales 25 entran en la categoría de sedentarios y 6 en la de activos, y 8 adultos de los cuales 6 entran en la categoría de sedentarios y 2 en la de activos. Las pruebas de hipótesis se realizan sobre las pendientes de entropia al pasar de reposo a esfuerzo (4mph para jovenes y 3.5mph para adultos)

H_0 = No existe una diferencia significativa entre ambas medias

H_1 = Existe una diferencia significativa entre ambas medias.

12.0.1 Ap entropy Completos

```
In [61]: activosAP=np.array(ActComplete['PendienteAp'])
         sedentariosAp=np.array(LowComplete['PendienteAp'])

In [62]: tEsfuerzo, pEsfuerzo = stats.ttest_ind(activosAP,sedentariosAp)

In [63]: print(tEsfuerzo,pEsfuerzo)

3.539456698009551 0.0011016056948872548
```

El valor de p=0.001101 es menor que el intervalo de confianza $\alpha = 0.05$ por lo tanto se rechaza H_0 y se acepta H_1, siendo así la diferencia entre las medias significativa

12.0.2 Sample Entropy Completos

```
In [64]: activosSamp=np.array(ActComplete['PendienteSamp'])
         sedentariosSamp=np.array(LowComplete['PendienteSamp'])

In [65]: tEsfuerzo, pEsfuerzo = stats.ttest_ind(activosSamp,sedentariosSamp)

In [66]: print(tEsfuerzo,pEsfuerzo)

3.1392675996687776 0.0033208447961831458
```

El valor de p=0.0.0033208 es menor que el intervalo de confianza $\alpha = 0.05$ por lo tanto se rechaza H_0 y se acepta H_1, siendo así la diferencia entre las medias significativa

12.0.3 Fuzzy entropy completos

```
In [67]: activosFuzz=np.array(ActComplete['PendienteFuzz'])
         sedentariosFuzz=np.array(LowComplete['PendienteFuzz'])

In [68]: tEsfuerzo, pEsfuerzo = stats.ttest_ind(activosFuzz,sedentariosFuzz)

In [69]: print(tEsfuerzo,pEsfuerzo)

2.967193369684203 0.005242381973250801
```

El valor de p=0.00524 es menor que el intervalo de confianza =0.05 por lo tanto se rechaza 0 y se acepta 1 , siendo así la diferencia entre las medias significativa

```
In [ ]:
```

```
In [70]: ActComplete.groupby('Genero').count()
```

```
Out[70]:         3.5MPHAp  3.5MPHFuzz  3.5MPHSamp  4MPHAp  4MPHFuzz  4MPHSamp  AVGp  \
         Genero
         H               7           7           7       7         7         7     7
         M               1           1           1       1         1         1     1

                 AVGr  Cuestionario  Edad  ...    Peso   Pesoã  RMSSDp  RMSSDr  \
         Genero                             ...
         H           7             7     7  ...       6      1       7       7
         M           1             1     1  ...       0      1       1       1

                 ReposoAp  ReposoFuzz  ReposoSamp  SDNNp  SDNNr  Talla
         Genero
         H               7           7           7      7      7      7
         M               1           1           1      1      1      1

         [2 rows x 27 columns]
```

```
In [71]: adultosLow.groupby('Genero').count()
```

```
Out[71]:         Persona  Edad  Talla  Pesoã  IMC  Cuestionario  ReposoSamp  \
         Genero
         H              5     5      5      5    5             5           5
         M              1     1      1      1    1             1           1

                 3.5MPHSamp  4MPHSamp  PendienteSamp  ...    4MPHAp  PendienteAp  AVGr  \
         Genero                                        ...
         H                5         5              5  ...         5            5     5
         M                1         1              1  ...         1            1     1

                 PNN50r  RMSSDr  SDNNr  AVGp  PNN50p  RMSSDp  SDNNp
         Genero
         H            5       5      5     5       5       5      5
         M            1       1      1     1       1       1      1

         [2 rows x 26 columns]
```

```
In [72]: print( 'edad activos',pd.to_numeric(ActComplete['Edad']).mean())
         print('edad sedentarios',pd.to_numeric(LowComplete['Edad']).mean())
```

```
edad activos 28.25
edad sedentarios 29.548387096774192
```

```
In [73]: (pd.to_numeric(jovenesHigh['Edad']).mean() + pd.to_numeric(jovenesLow['Edad'].mean())

Out[73]: 22.683333333333334

In [74]: jovenesLow['Edad'].mean()

Out[74]: 23.2

In [75]: pd.to_numeric(adultosHigh['Edad']).mean()

Out[75]: 46.5

In [76]: pd.to_numeric(adultosLow['Edad']).mean()

Out[76]: 56.0

In [78]: np.mean(pd.to_numeric(adultos['Edad']))

Out[78]: 53.625

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