```
In [1]: import os
        import numpy as np
        import pandas as pd
        import matplotlib.pyplot as plt
        %matplotlib inline
```

```
In [2]: path='/home/ucfilho/Documents/Aulas/Ago_29_2018'
        os.chdir(path)
```

```
In [3]: DAT=pd.read_csv("Hydrofoil_ago_29_2018.csv")
        #DAT=pd.read_csv("Hydrofoil_ago_29_2018.csv",index_col=
        "emit")
```

```
In [4]: Index=[2,3,4,5,6,7]
        Dat_Select=[]
        Dat_Select=DAT.iloc[:,Index].copy()
        print(Dat_Select.head())
```

```
   Hydrofoil    Froude  Resistence   Sinkage      Trim
Power
0          1  0.000000    0.000000  0.000000  0.000000
0.000000
1          1  0.103733    2.549729 -0.689028  1.353022
0.950991
2          1  0.124480    3.628461 -0.835413  1.346323
1.624000
3          1  0.165973    6.374322 -1.864337  1.361538
3.803965
4          1  0.186719    8.217973 -2.301539  1.378858
5.517212
```

In [5]:

```
# normatizando os dados (existe forma automatica de faz
er nao discutiremos
def normalizeCols(M):
    Num=len(M.columns)
    for i in range(Num):
        Max=float(np.max(M.iloc[:,[i]]))
        Min=float(np.min(M.iloc[:,[i]]))
        a=(Max+Min)/2
        b=(Max-Min)/2
        M.iloc[:,[i]] = M.iloc[:,[i]].apply(lambda x: (
x-a)/b)
    return M
DAT=normalizeCols(Dat_Select)
print(Dat_Select.head())
```

```
   Hydrofoil    Froude  Resistence   Sinkage      Trim
Power
0       -1.0 -1.000000   -1.000000 -0.883085 -1.000000 -
1.000000
1       -1.0 -0.913570   -0.986458 -0.895478 -0.459481 -
0.999415
2       -1.0 -0.896283   -0.980729 -0.898111 -0.462157 -
0.999001
3       -1.0 -0.861711   -0.966146 -0.916618 -0.456079 -
0.997659
4       -1.0 -0.844425   -0.956354 -0.924482 -0.449160 -
0.996605
```

In [6]:

```
X=DAT.iloc[:,[2,3]]
print(X.head())
```

```
   Resistence   Sinkage
0   -1.000000 -0.883085
1   -0.986458 -0.895478
2   -0.980729 -0.898111
3   -0.966146 -0.916618
4   -0.956354 -0.924482
```

In [7]:

```
Index=[2,3,4,5]
Dat_Select=[]
Y=DAT.iloc[:,Index].copy()
print(Y.head())
```

```
   Resistence   Sinkage      Trim     Power
0   -1.000000 -0.883085 -1.000000 -1.000000
1   -0.986458 -0.895478 -0.459481 -0.999415
2   -0.980729 -0.898111 -0.462157 -0.999001
3   -0.966146 -0.916618 -0.456079 -0.997659
4   -0.956354 -0.924482 -0.449160 -0.996605
```

In [8]:

```
# parte futura.....
#train=data.sample(frac=0.4,random_state=200)
#test=data.drop(train.index)
```

```
In [9]:  #from sklearn.neural_network import MLPClassifier
         from sklearn.neural_network import MLPRegressor
```

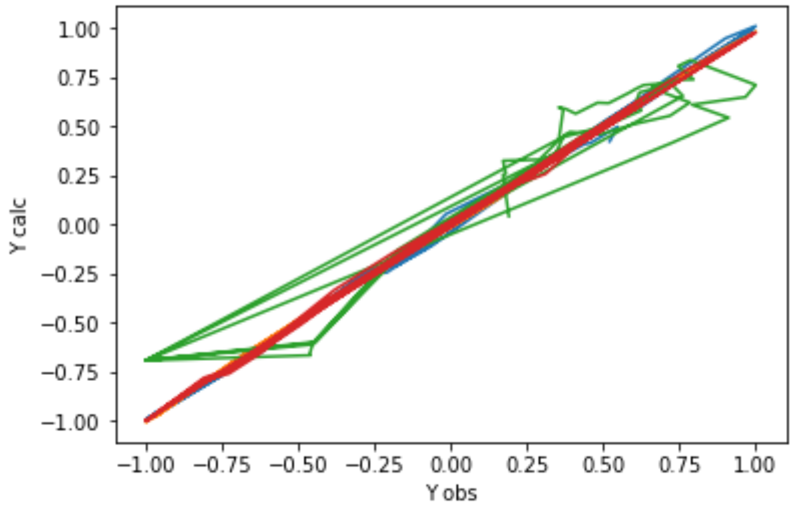
```
In [10]: clf = MLPRegressor(solver='lbfgs',activation='tanh',alp
         ha=1e-5,hidden_layer_sizes=(9, 8),
                             random_state=1)
```

```
In [11]: clf.fit(X, Y)
```

```
Out[11]: MLPRegressor(activation='tanh', alpha=1e-05, batch_size=
         'auto', beta_1=0.9,
                beta_2=0.999, early_stopping=False, epsilon=1e-08
         ,
                hidden_layer_sizes=(9, 8), learning_rate='constan
         t',
                learning_rate_init=0.001, max_iter=200, momentum=
         0.9,
                nesterovs_momentum=True, power_t=0.5, random_stat
         e=1, shuffle=True,
                solver='lbfgs', tol=0.0001, validation_fraction=0
         .1, verbose=False,
                warm_start=False)
```

```
In [12]: W=clf.predict(X)
```

```
In [13]: # plot results
         plt.plot(Y,W)
         plt.xlabel('Y obs')
         plt.ylabel('Y calc')
         plt.show()
```



```
In [14]: print(W[0:5,:])
```

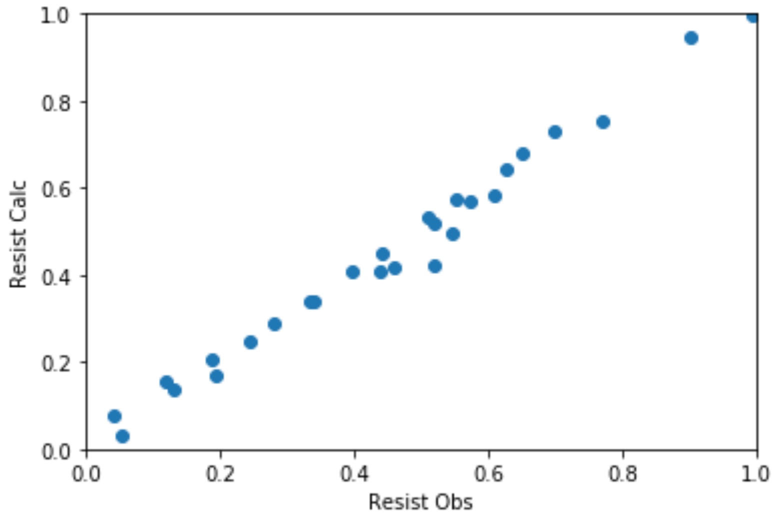
```
[[-0.99460209 -0.87616488 -0.6924928  -0.99810132]
 [-0.97993099 -0.8874524  -0.66605657 -0.99876307]
 [-0.97487506 -0.89028657 -0.65704438 -0.99874942]
 [-0.95640971 -0.90647294 -0.62429381 -0.99930575]
 [-0.94601848 -0.91394149 -0.60612231 -0.99914316]]
```

```
In [15]: print(Y.head())
```

```
   Resistence   Sinkage      Trim     Power
0   -1.000000 -0.883085 -1.000000 -1.000000
1   -0.986458 -0.895478 -0.459481 -0.999415
2   -0.980729 -0.898111 -0.462157 -0.999001
3   -0.966146 -0.916618 -0.456079 -0.997659
4   -0.956354 -0.924482 -0.449160 -0.996605
```

```
In [16]: resist_obs=[]
         resist_calc=[]
         resist_calc=W[:,0].copy()
         resist_obs=Y['Resistence'].copy()
         #print(resist_calc)
         #print(resist_obs)
         plt.scatter(resist_obs,resist_calc)
         plt.ylim((0, 1))
         plt.xlim((0, 1))
         plt.ylabel('Resist Calc')
         plt.xlabel('Resist Obs')
```

```
Out[16]: Text(0.5,0,'Resist Obs')
```



In [17]:

```
DAT=pd.read_csv("Hydrofoil_ago_29_2018.csv")
Index=[4,5,6,7]
Dat_Select=[]
Dat_Select=DAT.iloc[:,Index].copy()
print(Dat_Select.head())
```

```
   Resistence   Sinkage      Trim     Power
0    0.000000  0.000000  0.000000  0.000000
1    2.549729 -0.689028  1.353022  0.950991
2    3.628461 -0.835413  1.346323  1.624000
3    6.374322 -1.864337  1.361538  3.803965
4    8.217973 -2.301539  1.378858  5.517212
```

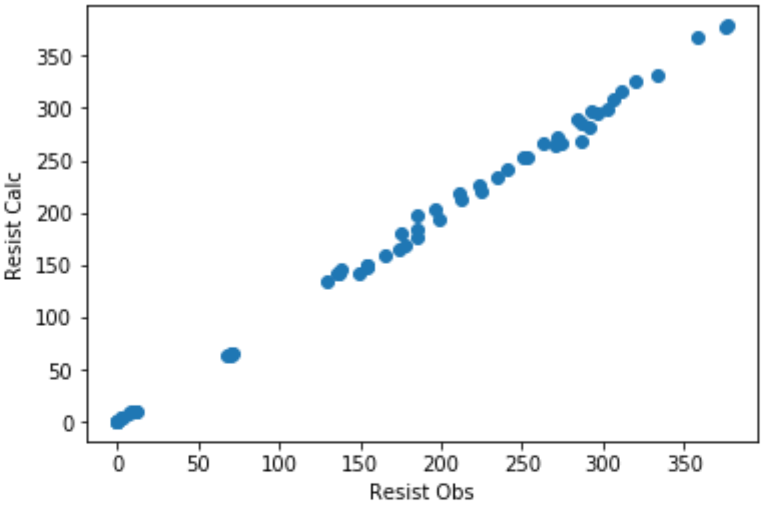
In [18]:

```
def Original(x,x_old):
    strings=list(x)
    for i in strings:
        max_x=x_old[i].max()
        min_x=x_old[i].min()
        a=(max_x+min_x)/2
        b=(max_x-min_x)/2
        x[i]=x[i]*b+a
    return x
W=pd.DataFrame(W)
col_names=list(Dat_Select)
W.columns = col_names # apage este linha para ver o q a
contece...
W=Original(W,Dat_Select)
print(W.head())
```

```
   Resistence   Sinkage      Trim     Power
0    1.016360  0.384735  0.769749  3.085458
1    3.778748 -0.242816  0.835924  2.010074
2    4.730717 -0.400387  0.858483  2.032263
3    8.207515 -1.300300  0.940464  1.128197
4   10.164055 -1.715528  0.985951  1.392416
```

```
In [19]: resist_obs=[]
         resist_calc=[]
         resist_calc=W['Resistence'].copy()
         resist_obs=Dat_Select['Resistence'].copy()
         plt.scatter(resist_obs,resist_calc)
         plt.ylabel('Resist Calc')
         plt.xlabel('Resist Obs')
```

```
Out[19]: Text(0.5,0,'Resist Obs')
```



```
In [20]: ynew = np.c_[resist_obs,resist_calc]
```

In [21]:

```
print(ynew)
```

```
[[  0.            1.01635989]
 [  2.549729      3.77874752]
 [  3.6284605     4.73071662]
 [  6.3743225     8.20751471]
 [  8.2179727    10.16405471]
 [ 10.36562905   10.38322693]
 [ 66.9794195    64.5289641 ]
 [129.5458465   135.10967241]
 [153.768272    150.60019341]
 [184.757286    176.62843836]
 [224.572285    220.52860784]
 [250.9521735   252.08909292]
 [262.81822     265.48634201]
 [284.39285     288.68291726]
 [292.23817     296.24943502]
 [306.163613    309.10766144]
 [375.398562    376.39782908]
 [  0.            1.01635989]
 [ 11.13054775   11.11239643]
 [ 69.627215     64.67566132]
 [136.8027675   142.97746869]
 [154.4547375   148.93912043]
 [177.500365    168.80711704]
 [198.5846625   194.05803547]
 [212.804305    213.77943487]
 [241.24359     242.2682787 ]
 [271.644205    273.04759621]
 [310.870805    315.9570236 ]
 [319.69679     325.94499548]
 [357.942725    366.8424962 ]
 [376.57536     378.61251041]
 [  0.            1.01635989]
 [ 10.8853815     9.60431571]
 [ 70.60788      65.99826254]
 [138.273765    146.38844025]
 [154.4547375   148.36978484]
 [173.577705    165.29211157]
 [184.561153    184.06744338]
 [196.133       202.95110081]
 [223.59162     227.16087615]
 [252.5212375   252.2832566 ]
 [286.35418     285.57705621]
 [296.16083     295.08922848]
 [303.025485    298.3143906 ]
 [333.4261      330.44324438]
 [  0.            1.01635989]
 [ 11.2776475    10.5644766 ]
 [ 71.588545     66.59835373]
 [135.8221025   141.65308762]
 [148.5707475   142.10231888]
 [165.143986    158.94692132]
 [174.55837     180.67363043]
 [185.345685    198.3422322 ]
 [210.646842    217.95368582]
 [234.378935    234.76529796]
 [270.66354     265.31539097]
```

In [22]:

```
DAT=pd.read_csv("Hydrofoil_ago_29_2018.csv")
train=DAT.sample(frac=0.8,random_state=None) # poderia ser frac=0.5? sim ou nao?
test=DAT.drop(train.index)
print(train.head())
print("==============")
print(train.shape[0])
print("==============")
print(test.head())
print("==============")
print(test.shape[0])
```

```
    Unnamed: 0  Case  Hydrofoil    Froude  Resistence
Sinkage      Trim  \
35           36    36           3  0.829864  154.454737  2
9.937597  4.156960
31           32    32           3  0.000000    0.000000
0.000000  0.000000
29           30    30           2  2.240634  357.942725  8
9.609948  3.426487
51           52    52           4  1.244797  174.558370  6
9.942361  4.066262
23           24    24           2  1.244797  198.584663  5
9.819143  3.967196

          Power
35   460.864971
31     0.000000
29  2883.697961
51   781.275856
23   888.811015
==============
47
==============
    Unnamed: 0  Case  Hydrofoil    Froude  Resistence
Sinkage      Trim  \
7             8     8           1  0.622398  129.545847
9.513175  4.409404
13           14    14           1  1.867195  284.392850  8
1.246826  4.922507
14           15    15           1  2.026944  292.238170  8
4.130501  4.484304
25           26    26           2  1.659729  241.243590  7
7.760720  3.708596
37           38    38           3  1.244797  184.561153  6
4.169399  4.465222

          Power
7    289.906013
13  1909.297737
14  2129.825283
25  1439.654386
37   826.045596
==============
12
```

In [23]:

```
Index=[4,5,6,7]
y_test=[]
y_train=[]
y_test=test.iloc[:,Index].copy()
y_train=train.iloc[:,Index].copy()
Index=[2,3]
x_test=[]
x_train=[]
x_test=test.iloc[:,Index].copy()
x_train=train.iloc[:,Index].copy()
```

In [24]:

```
def Codifica(x,x_old):
    strings=list(x)
    for i in strings:
        max_x=x_old[i].max()
        min_x=x_old[i].min()
        a=(max_x+min_x)/2
        b=(max_x-min_x)/2
        x[i]=(x[i]-a)/b
    return x
y_train_old=[]
y_train_old=y_train.copy()
x_train_old=[]
x_train_old=x_train.copy()
col_names=list(Dat_Select)
W.columns = col_names # apage este linha para ver o q a
contece...
x_train=Codifica(x_train,x_train_old)
y_train=Codifica(y_train,y_train_old)
x_test=Codifica(x_test,x_train_old)
y_test=Codifica(y_test,y_train_old)
print(y_test.head())
```

```
    Resistence   Sinkage      Trim     Power
7    -0.311979 -0.711975  0.761513 -0.821602
13    0.510417  0.578270  0.966493  0.174914
14    0.552083  0.630138  0.791435  0.310618
25    0.281250  0.515567  0.481548 -0.114088
37   -0.019792  0.271105  0.783812 -0.491681
```

In [25]:

```
clf = MLPRegressor(solver='lbfgs',activation='tanh',alp
ha=1e-5,hidden_layer_sizes=(9, 8),
                    random_state=1)
```

In [26]:

```
clf.fit(x_train, y_train)
```

Out[26]:

```
MLPRegressor(activation='tanh', alpha=1e-05, batch_size=
'auto', beta_1=0.9,
       beta_2=0.999, early_stopping=False, epsilon=1e-08
,
       hidden_layer_sizes=(9, 8), learning_rate='constan
t',
       learning_rate_init=0.001, max_iter=200, momentum=
0.9,
       nesterovs_momentum=True, power_t=0.5, random_stat
e=1, shuffle=True,
       solver='lbfgs', tol=0.0001, validation_fraction=0
.1, verbose=False,
       warm_start=False)
```

In [27]:

```
y_calc_train=clf.predict(x_train)
y_calc_test=clf.predict(x_test)
```

In [28]:

```
y_calc_train=pd.DataFrame(y_calc_train)
y_calc_test=pd.DataFrame(y_calc_test)
col_names=list(y_train)
y_calc_train.columns = col_names
y_calc_test.columns = col_names
print(y_calc_train.head())
```

```
   Resistence   Sinkage      Trim     Power
0   -0.148628 -0.362080  0.732977 -0.734439
1   -0.976626 -0.880240 -0.962391 -1.003720
2    0.837659  0.784199  0.340408  0.720254
3   -0.063406  0.401304  0.529070 -0.529966
4    0.058370  0.180131  0.554061 -0.476177
```

In [29]:

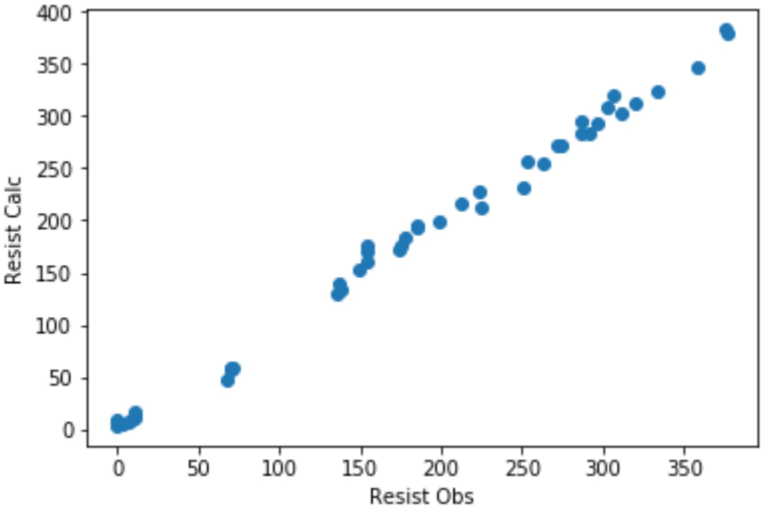
```
def Original(x,x_old):
    strings=list(x)
    for i in strings:
        max_x=x_old[i].max()
        min_x=x_old[i].min()
        a=(max_x+min_x)/2
        b=(max_x-min_x)/2
        x[i]=x[i]*b+a
    return x
y_calc_train=Original(y_calc_train,y_train_old)
y_obs_train=Original(y_train,y_train_old)
y_calc_test=Original(y_calc_test,y_train_old)
y_obs_test=Original(y_test,y_train_old)
```

In [30]:

```
resist_obs_train=[]
resist_calc_train=[]
resist_calc=y_calc_train['Resistence'].copy()
resist_obs=y_train_old['Resistence'].copy()
```

```
In [31]: plt.scatter(resist_obs,resist_calc)
         plt.ylabel('Resist Calc')
         plt.xlabel('Resist Obs')

Out[31]: Text(0.5,0,'Resist Obs')
```

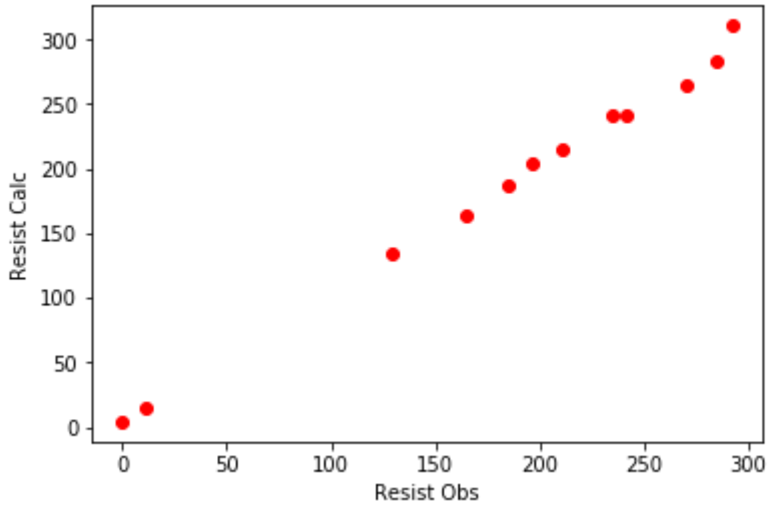


```
In [40]: resist_obs_test=[]
         resist_calc_test=[]
         resist_calc_test=y_calc_test['Resistence'].copy()
         resist_obs_test=y_obs_test['Resistence'].copy()
         print(resist_obs_test.head())

         7     129.545847
         13    284.392850
         14    292.238170
         25    241.243590
         37    184.561153
         Name: Resistence, dtype: float64
```

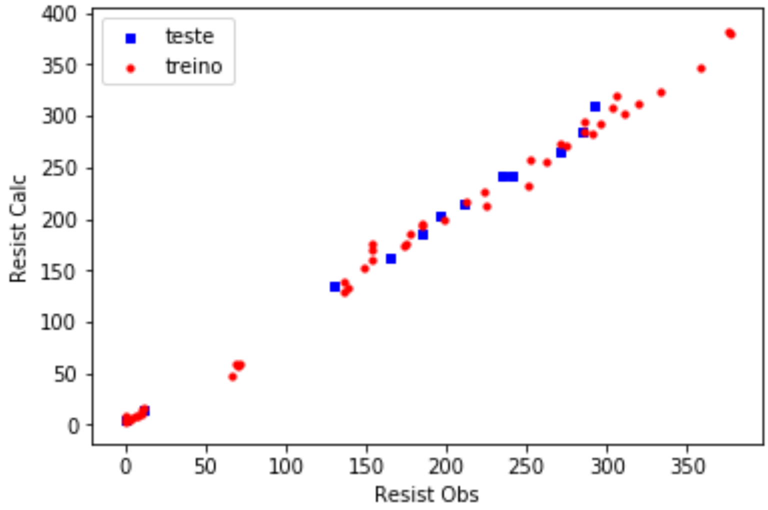
```
In [42]: plt.scatter(resist_obs_test,resist_calc_test,c='red')
         plt.ylabel('Resist Calc')
         plt.xlabel('Resist Obs')

Out[42]: Text(0.5,0,'Resist Obs')
```



```
In [44]: fig = plt.figure()
         ax1 = fig.add_subplot(111)

         ax1.scatter(resist_obs_test,resist_calc_test, s=10, c='
         b', marker="s", label='teste')
         ax1.scatter(resist_obs,resist_calc, s=10, c='r', marker
         ="o", label='treino')
         plt.legend(loc='upper left')
         plt.ylabel('Resist Calc')
         plt.xlabel('Resist Obs')
         plt.show()
```


teste
treino
Resist Calc
Resist Obs