EDA And Baseline on Motor Temperature Estimation

In [66]:

```
!pip install seaborn
!pip install scikit-learn==0.23.2
```

```
Requirement already satisfied: seaborn in c:\users\pedro\anaconda3\lib\site-
packages (0.11.0)
Requirement already satisfied: pandas>=0.23 in c:\users\pedro\anaconda3\lib
\site-packages (from seaborn) (1.1.3)
Requirement already satisfied: scipy>=1.0 in c:\users\pedro\anaconda3\lib\si
te-packages (from seaborn) (1.5.2)
Requirement already satisfied: matplotlib>=2.2 in c:\users\pedro\anaconda3\l
ib\site-packages (from seaborn) (3.3.2)
Requirement already satisfied: numpy>=1.15 in c:\users\pedro\anaconda3\lib\s
ite-packages (from seaborn) (1.19.2)
Requirement already satisfied: pytz>=2017.2 in c:\users\pedro\anaconda3\lib
\site-packages (from pandas>=0.23->seaborn) (2020.1)
Requirement already satisfied: python-dateutil>=2.7.3 in c:\users\pedro\anac
onda3\lib\site-packages (from pandas>=0.23->seaborn) (2.8.1)
Requirement already satisfied: certifi>=2020.06.20 in c:\users\pedro\anacond
a3\lib\site-packages (from matplotlib>=2.2->seaborn) (2020.6.20)
Requirement already satisfied: pillow>=6.2.0 in c:\users\pedro\anaconda3\lib
\site-packages (from matplotlib>=2.2->seaborn) (8.0.1)
Requirement already satisfied: cycler>=0.10 in c:\users\pedro\anaconda3\lib
\site-packages (from matplotlib>=2.2->seaborn) (0.10.0)
Requirement already satisfied: kiwisolver>=1.0.1 in c:\users\pedro\anaconda3
\lib\site-packages (from matplotlib>=2.2->seaborn) (1.3.0)
Requirement already satisfied: pyparsing!=2.0.4,!=2.1.2,!=2.1.6,>=2.0.3 in
c:\users\pedro\anaconda3\lib\site-packages (from matplotlib>=2.2->seaborn)
(2.4.7)
Requirement already satisfied: six>=1.5 in c:\users\pedro\anaconda3\lib\site
-packages (from python-dateutil>=2.7.3->pandas>=0.23->seaborn) (1.15.0)
Requirement already satisfied: scikit-learn==0.23.2 in c:\users\pedro\anacon
da3\lib\site-packages (0.23.2)
Requirement already satisfied: threadpoolctl>=2.0.0 in c:\users\pedro\anacon
da3\lib\site-packages (from scikit-learn==0.23.2) (2.1.0)
Requirement already satisfied: scipy>=0.19.1 in c:\users\pedro\anaconda3\lib
\site-packages (from scikit-learn==0.23.2) (1.5.2)
Requirement already satisfied: numpy>=1.13.3 in c:\users\pedro\anaconda3\lib
\site-packages (from scikit-learn==0.23.2) (1.19.2)
Requirement already satisfied: joblib>=0.11 in c:\users\pedro\anaconda3\lib
\site-packages (from scikit-learn==0.23.2) (0.17.0)
```

Importando Bibliotecas

In [67]:

```
import numpy as np #Biblioteca "matemática"
import pandas as pd #Biblioteca para manipulação e análise de dados
import matplotlib.pyplot as plt #Extenção da biblioteca que faz a pltagem de gráficos e pon
from matplotlib.colors import rgb2hex
import seaborn as sns
import os #Funcionalidade simplificadas de sistema operacionais
print(os.listdir())
from sklearn import neighbors
from sklearn.neighbors import KNeighborsRegressor
from sklearn.metrics import mean_squared_error
from sklearn.metrics import r2_score
from sklearn.model_selection import train_test_split
import sklearn.metrics
from sklearn.model_selection import cross_val_score # Cross Validation Function.
from sklearn.model_selection import KFold # KFold Class.
from sklearn.linear_model import LinearRegression # Linear Regression class.
from sklearn.metrics import mean_squared_error

%matplotlib inline
plt.style.use('bmh')
```

```
['.ipynb_checkpoints', 'activate.csh', 'activate.fish', 'activate.nu', 'acti
vate.ps1', 'activate.txt', 'activate_this.py', 'alembic.txt', 'archive.zip',
'automl_inicio.ipynb', 'AutoSklearn - Eletric Motor.ipynb', 'Book - Hands-on
atuomated machine learning.ipynb', 'Curso Data science.ipynb', 'cygdb.txt',
'cython.txt', 'cythonize.txt', 'dask-scheduler.txt', 'dask-ssh.txt', 'dask-w
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rn-Copy2.ipynb', 'Eletric Motor_Autosklearn.ipynb', 'Eletric Motor_Autosklea
rn_H2O.ipynb', 'Eletric Motor_pycaret.ipynb', 'f2py.txt', 'f2py3.8', 'f2py3.
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ndas_profiling.txt', 'pasteurize.txt', 'phik_trial.txt', 'pip-3.8', 'pip.tx
t', 'pip3.8', 'pip3.txt', 'plac_runner.py', 'pycc.txt', 'pyftmerge.txt', 'py
ftsubset.txt', 'pygmentize.txt', 'python', 'python3', 'python3.8', 'send2tra
sh.txt', 'smac.txt', 'spacy', 'sqlformat.txt', 'tabulate.txt', 'tqdm.txt',
'ttx.txt', 'wheel-3.8', 'wheel.txt', 'wheel3.8', 'wheel3.txt', 'wordcloud_cl
i.txt', 'wsdump.txt', '__pycache__']
```

Lendo o arquivo

In [68]:

```
df=pd.read_csv('measures_v2.csv', usecols=[0,1,2,3,4,5,6,7,8,9,10,11])
target = df.pop('pm') #Temperatura do rotor
df = pd.concat([df, target], axis=1)
df = df.sample(frac=1,random_state=0) #embaralha os dados do dataframe #Ajuda a previnir o
df.reset_index(drop=True, inplace=True) #Faz com que o Index volte a ser o que era antes
```

In [69]:

```
df.head()
```

Out[69]:

	u_q	coolant	stator_winding	u_d	stator_tooth	motor_speed	i_d	
0	41.938923	18.744030	66.684830	-123.478027	46.080647	4749.964355	-187.964111	7
1	-0.431508	59.902590	85.079312	-0.878644	76.299257	0.057160	-2.000745	
2	-1.541598	33.149664	48.669293	-0.333442	45.330586	0.001482	-2.000673	
3	42.387482	44.949261	104.791174	-123.337533	90.274398	5112.368164	-181.587703	6
4	15.335679	18.755226	113.366333	-130.067474	84.144737	3999.963135	-205.157623	9

In [70]:

```
split_index=int(len(df) * 0.75)

train_df = df[:split_index] #Primeiros 75%
test_df = df[split_index:] #outros 25% restantes

train_df.info()
test_df.info()
```

```
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 998112 entries, 0 to 998111
Data columns (total 12 columns):
 #   Column          Non-Null Count   Dtype  
---  ------          --------------   -----  
 0   u_q             998112 non-null  float64
 1   coolant         998112 non-null  float64
 2   stator_winding  998112 non-null  float64
 3   u_d             998112 non-null  float64
 4   stator_tooth    998112 non-null  float64
 5   motor_speed     998112 non-null  float64
 6   i_d             998112 non-null  float64
 7   i_q             998112 non-null  float64
 8   stator_yoke     998112 non-null  float64
 9   ambient         998112 non-null  float64
 10  torque          998112 non-null  float64
 11  pm              998112 non-null  float64
dtypes: float64(12)
memory usage: 91.4 MB
<class 'pandas.core.frame.DataFrame'>
RangeIndex: 332704 entries, 998112 to 1330815
Data columns (total 12 columns):
 #   Column          Non-Null Count   Dtype  
---  ------          --------------   -----  
 0   u_q             332704 non-null  float64
 1   coolant         332704 non-null  float64
 2   stator_winding  332704 non-null  float64
 3   u_d             332704 non-null  float64
 4   stator_tooth    332704 non-null  float64
 5   motor_speed     332704 non-null  float64
 6   i_d             332704 non-null  float64
 7   i_q             332704 non-null  float64
 8   stator_yoke     332704 non-null  float64
 9   ambient         332704 non-null  float64
 10  torque          332704 non-null  float64
 11  pm              332704 non-null  float64
dtypes: float64(12)
memory usage: 30.5 MB
```

Retira a última coluna que é no target do modelo de treinamento e modelos de teste

In [71]:

```
X_train = train_df.to_numpy()[:, :-1]
y_train = train_df.to_numpy()[:, -1]

X_test = test_df.to_numpy()[:, :-1]
y_test = test_df.to_numpy()[:, -1]
```

Criando o modelo para o treinamento do algorítmo

In [73]:

```
knn_model= neighbors.KNeighborsRegressor()
knn_treino=knn_model.fit(X_train,y_train)
```

Fazendo as predições dos valores

In [74]:

```
Pred_train_y =knn_model.predict(X_train)
```

In [75]:

```
Pred_test_y =knn_model.predict(X_test)
```

Observando o resultado das predições a partir do R^2 e o Mean Squared Error

In [76]:

```
import sklearn.metrics
print("Scores R2 de treino", sklearn.metrics.r2_score(y_train,Pred_train_y))
print("Scores R2 de teste", sklearn.metrics.r2_score(y_test,Pred_test_y))
```

```
Scores R2 de treino 0.975183329761486
Scores R2 de teste 0.9608577627930146
```

In [77]:

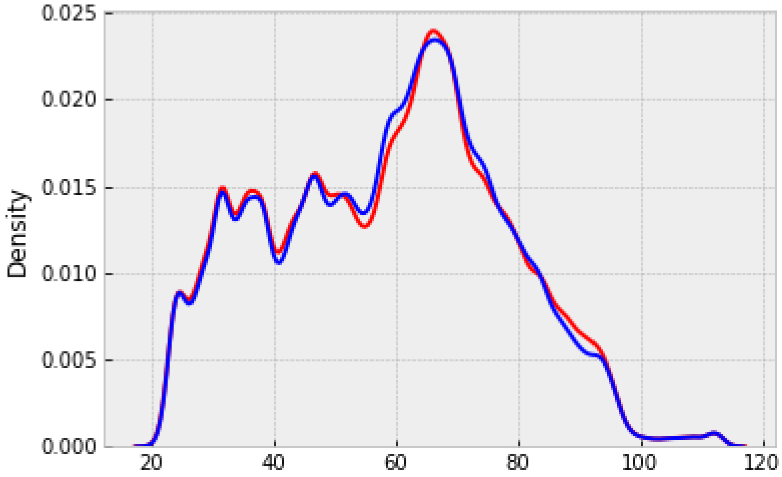
```
MSE_treino=sklearn.metrics.mean_squared_error(y_train, Pred_train_y)

MSE_teste=sklearn.metrics.mean_squared_error(y_test, Pred_test_y)

print("Erro quadrático Médio Treino", MSE_treino)

print("Erro quadrático Médio Teste", MSE_teste)
```

```
Erro quadrático Médio Treino 8.96069404148651
Erro quadrático Médio Teste 14.130213469806101
```

In [78]:

```
#Dados de treino
ax1 = sns.distplot(y_train, hist=False, color="r", label="Valor real")
sns.distplot(Pred_train_y, hist=False, color="b", label="Valor do treino" , ax=ax1);
```

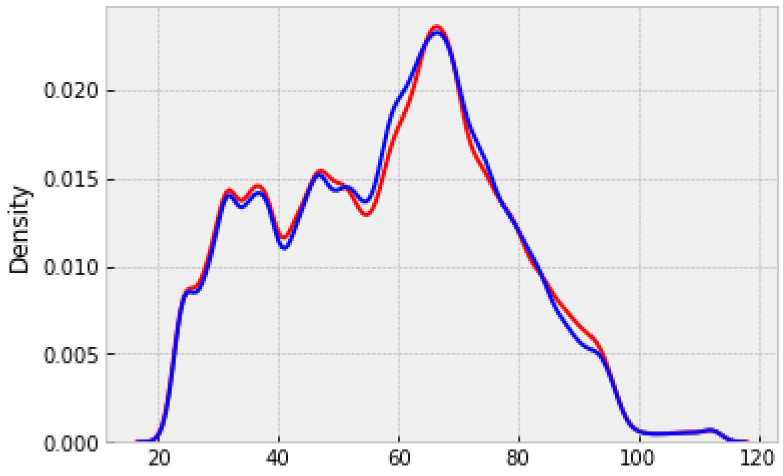
```
C:\Users\pedro\anaconda3\lib\site-packages\seaborn\distributions.py:2551: Fu
tureWarning: `distplot` is a deprecated function and will be removed in a fu
ture version. Please adapt your code to use either `displot` (a figure-level
function with similar flexibility) or `kdeplot` (an axes-level function for
kernel density plots).
  warnings.warn(msg, FutureWarning)
C:\Users\pedro\anaconda3\lib\site-packages\seaborn\distributions.py:2551: Fu
tureWarning: `distplot` is a deprecated function and will be removed in a fu
ture version. Please adapt your code to use either `displot` (a figure-level
function with similar flexibility) or `kdeplot` (an axes-level function for
kernel density plots).
  warnings.warn(msg, FutureWarning)
```



In [84]:

```
#Dados de Teste
ax1 = sns.distplot(y_test, hist=False, color="r", label="Valor real")
sns.distplot(Pred_test_y, hist=False, color="b", label="Valor do treino" , ax=ax1);
```

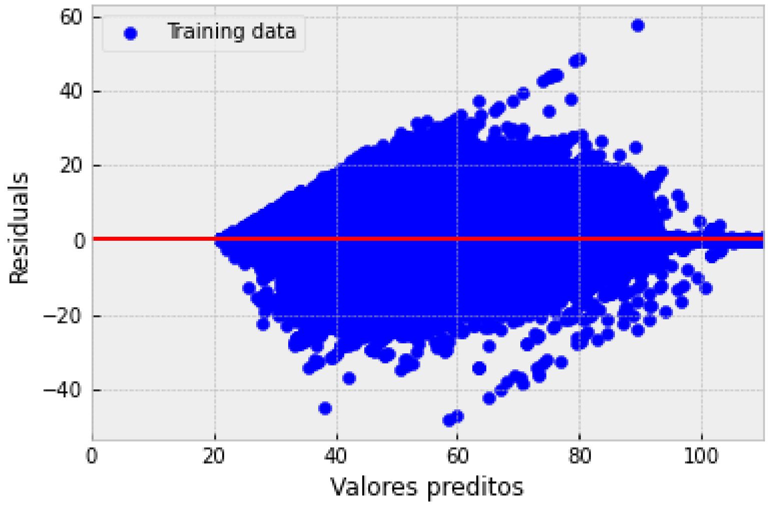
```
C:\Users\pedro\anaconda3\lib\site-packages\seaborn\distributions.py:2551: Fu
tureWarning: `distplot` is a deprecated function and will be removed in a fu
ture version. Please adapt your code to use either `displot` (a figure-level
function with similar flexibility) or `kdeplot` (an axes-level function for
kernel density plots).
  warnings.warn(msg, FutureWarning)
C:\Users\pedro\anaconda3\lib\site-packages\seaborn\distributions.py:2551: Fu
tureWarning: `distplot` is a deprecated function and will be removed in a fu
ture version. Please adapt your code to use either `displot` (a figure-level
function with similar flexibility) or `kdeplot` (an axes-level function for
kernel density plots).
  warnings.warn(msg, FutureWarning)
```



Dados do treino

In [86]:

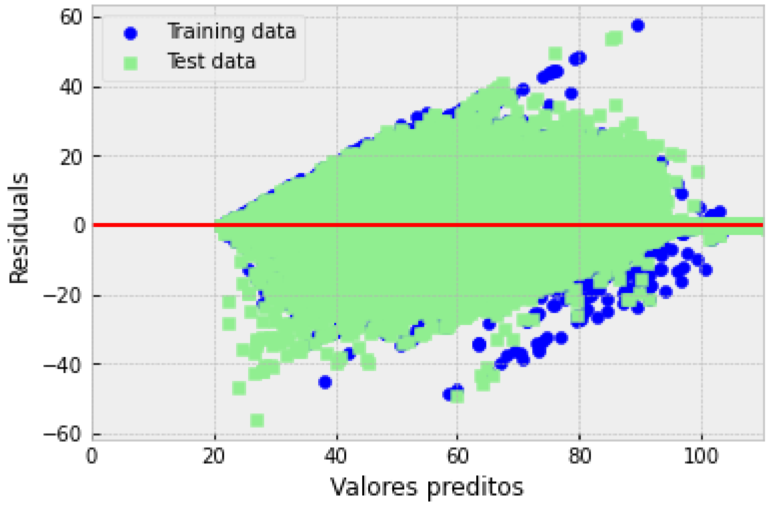
```
plt.scatter(Pred_train_y,Pred_train_y-  y_train,c='blue', marker='o', label='Training data'
plt.xlabel('Valores preditos')
plt.ylabel('Residuals')
plt.legend(loc='upper left')
plt.hlines(y=0, xmin=0, xmax=110, lw=2, color='red')
plt.xlim([0, 110])
plt.show()
```



Dados do treino e teste

In [87]:

```
plt.scatter(Pred_train_y,Pred_train_y-  y_train,c='blue', marker='o', label='Training data'
plt.scatter(Pred_test_y, Pred_test_y - y_test,c='lightgreen', marker='s', label='Test data'
plt.xlabel('Valores preditos')
plt.ylabel('Residuals')
plt.legend(loc='upper left')
plt.hlines(y=0, xmin=0, xmax=110, lw=2, color='red')
plt.xlim([0, 110])
plt.show()
```



Validação Cruzada

In [82]:

```
df=pd.read_csv('measures_v2.csv', usecols=[0,1,2,3,4,5,6,7,8,9,10,11])
target = df.pop('pm') #Temperatura do rotor
df = pd.concat([df, target], axis=1)
X_train = train_df.to_numpy()[:, :-1]
y_train = train_df.to_numpy()[:, -1]
X = test_df.to_numpy()[:, :-1]
y = test_df.to_numpy()[:, -1]
```

In [83]:

```
knn_model= neighbors.KNeighborsRegressor()
kfold  = KFold(n_splits=10, shuffle=True) # shuffle=True, Shuffle (embaralhar) the data.
result = cross_val_score(knn_model, X, y, cv = kfold)

print("K-Fold (R^2) Scores: {0}".format(result))
print("Média do R^2 para a validação cruzada K-Fold: {0}".format(result.mean()))
```

```
K-Fold (R^2) Scores: [0.94541737 0.94799604 0.94628656 0.94580131 0.94544845
0.94837941
 0.94862884 0.94789712 0.94850263 0.94689372]
Média do R^2 para a validação cruzada K-Fold: 0.9471251459685343
```