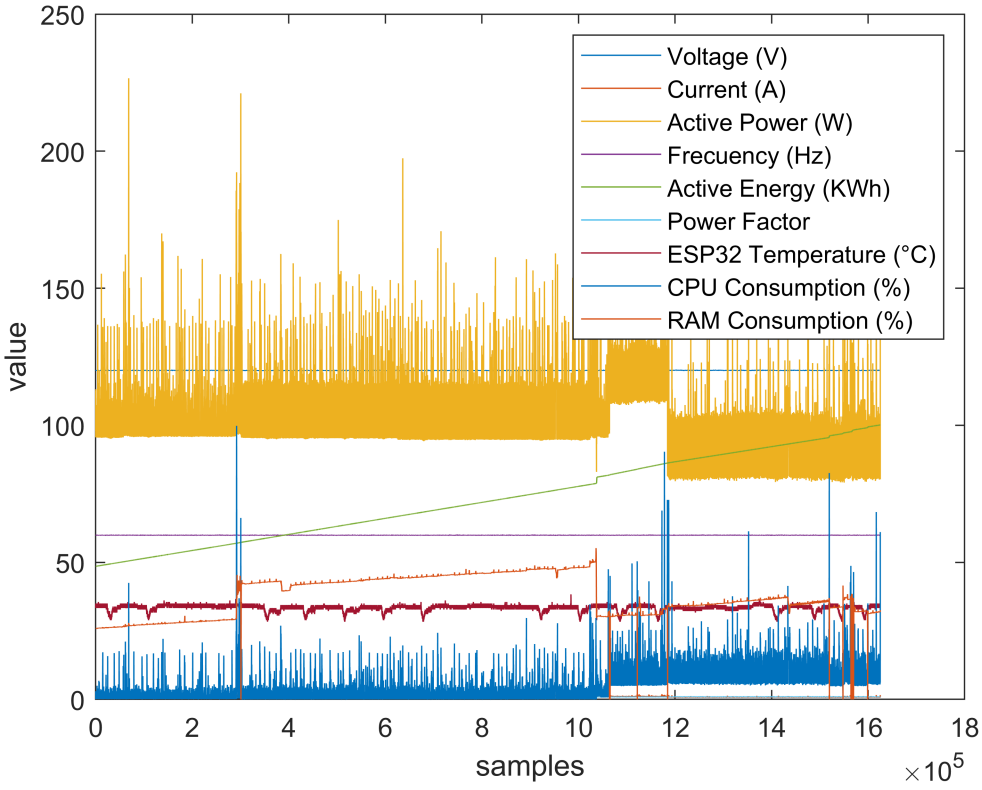
Load Data, Sampling Rate=1sample/1seg

Date = '2021-05-27 00:00:00' AND '2021-06-17 22:04:21'

```
clear;clc;%clear all
%Prepare the raw dataset
%load('./data/dataset_raw.mat');%Load table data
%data(:,19)=[];%delete empty data
%data(:,13:17)=[];%delete empty data
%data(:,1)=[];%delete the topics
load('./data/dataset.mat');%Load table data
dataNew=table2array(data(:,4:12));% Array Double
%csvwrite('data.csv',dataNew);%Save as .csv file
```

Plot Data (Dataset)

```
figure
plot(dataNew);xlabel('samples');ylabel('value');
legend('Voltage (V)','Current (A)','Active Power (W)','Frecuency (Hz)','Active Energy (KWh)','F
```



Statital Information (Dataset)

```
xds_v = datastats(dataNew(:,1))%Voltage (V)
```

```
xds_v = struct with fields:
       num: 1625175
       max: 120.2000
       min: 119.4000
```

```
      mean: 120.0236
    median: 120
     range: 0.8000
       std: 0.0648
```

```
xds_C = datastats(dataNew(:,2))%Current (A)
```

```
xds_C = struct with fields:
       num: 1625175
       max: 1.9800
       min: 0.7000
      mean: 0.9240
    median: 0.9300
     range: 1.2800
       std: 0.0934
```

```
xds_AP = datastats(dataNew(:,3))%Active Power (W)
```

```
xds_AP = struct with fields:
       num: 1625175
       max: 226.6000
       min: 79.1000
      mean: 98.9189
    median: 96.6000
     range: 147.5000
       std: 9.3631
```

```
xds_F = datastats(dataNew(:,4))%Frecuency (Hz)
```

```
xds_F = struct with fields:
       num: 1625175
       max: 60.1000
       min: 59.7000
      mean: 59.9668
    median: 60
     range: 0.4000
       std: 0.0488
```

```
xds_AE = datastats(dataNew(:,5))%Active Energy (KWh)
```

```
xds_AE = struct with fields:
       num: 1625175
       max: 100.1200
       min: 48.5600
      mean: 73.3169
    median: 72.2300
     range: 51.5600
       std: 14.9472
```

```
xds_AE = datastats(dataNew(:,6))%Power Factor
```

```
xds_AE = struct with fields:
       num: 1625175
       max: 1
       min: 0.7300
      mean: 0.8946
    median: 0.8600
     range: 0.2700
       std: 0.0443
```

```
xds_T = datastats(dataNew(:,7))%ESP32 Temperature (°C)
```

```
xds_T = struct with fields:
       num: 1625175
       max: 38.3300
       min: 28.3300
      mean: 33.2923
    median: 33.8900
     range: 10
       std: 1.0580
```

```
xds_CPU = datastats(dataNew(:,8))%CPU Consumption (%)
```

```
xds_CPU = struct with fields:
       num: 1625175
       max: 99.8000
       min: 0
      mean: 3.8781
    median: 1.3000
     range: 99.8000
       std: 4.5249
```

```
xds_RAM = datastats(dataNew(:,9))%RAM Consumption (%)
```

```
xds_RAM = struct with fields:
       num: 1625175
       max: 55.2000
       min: 0
      mean: 37.6688
    median: 36.3500
     range: 55.2000
       std: 7.0824
```

1 - Preprocessing (Normalization)

```
DataNorm=[];
for i = 1:size(dataNew,2)
    DataNorm=[DataNorm (dataNew(:,i)-min(dataNew(:,i)))/(max(dataNew(:,i))-min(dataNew(:,i)))];
end
```

2 - Feature Extraction (rms by temporary window)

```
% Select only one TimeStep
% not enough data... TimeStep =2592000;% one month in second
%TimeStep =604800;% one week in second (only 2 weeks)
%TimeStep =86400;% one day in second (ok)
%TimeStep =3600;% one hour in second (ok)
TimeStep =60;% one minute in second
%TimeStep =1;% one second

DataFeatures=[];
for i = 1:size(DataNorm,2)%columnas
    Feature=[];
    for j = 1:TimeStep:size(DataNorm,1)-TimeStep%filas
        Feature=[Feature; rms(DataNorm(j:j+TimeStep,i))];
    end
    DataFeatures=[DataFeatures Feature];
end
```

```
% Feature 1: rms(Active Power (W))
xds_F1 = datastats(DataFeatures(:,1))
```

```
xds_F1 = struct with fields:
       num: 27086
       max: 0.8693
       min: 0.4401
      mean: 0.7819
    median: 0.7953
     range: 0.4292
       std: 0.0542
```

```
% Feature 2: rms(Active Energy (KWh))
xds_F2 = datastats(DataFeatures(:,2))
```

```
xds_F2 = struct with fields:
       num: 27086
       max: 0.5796
       min: 0.0797
      mean: 0.1780
    median: 0.1887
     range: 0.5000
       std: 0.0654
```

```
% Feature 3: rms(CPU Consumption (%))
xds_F3 = datastats(DataFeatures(:,3))
```

```
xds_F3 = struct with fields:
       num: 27086
       max: 0.5551
       min: 0.0922
      mean: 0.1386
    median: 0.1253
     range: 0.4630
       std: 0.0536
```

```
% Feature 4: rms(RAM Consumption (%))
xds_F4 = datastats(DataFeatures(:,4))
```

```
xds_F4 = struct with fields:
       num: 27086
       max: 0.7828
       min: 0.2772
      mean: 0.6762
    median: 0.6820
     range: 0.5055
       std: 0.0494
```

3 - Feature Selection

```
%corrplot(DataNorm)
R = corrcoef(DataFeatures)
```

```
R = 9×9
    1.0000   -0.7712   -0.9131    0.2255   -0.0330   -0.0177    0.2061   -0.3039 ···
   -0.7712    1.0000    0.8662    0.0108   -0.4388   -0.5201   -0.0306   -0.2088
   -0.9131    0.8662    1.0000    0.0064   -0.0161   -0.0243   -0.0489    0.2964
    0.2255    0.0108    0.0064    1.0000   -0.0134   -0.0117    0.0063   -0.0098
   -0.0330   -0.4388   -0.0161   -0.0134    1.0000    0.8466   -0.0452    0.7864
   -0.0177   -0.5201   -0.0243   -0.0117    0.8466    1.0000   -0.0195    0.9216
    0.2061   -0.0306   -0.0489    0.0063   -0.0452   -0.0195    1.0000   -0.0266
```

```
   -0.3039   -0.2088    0.2964   -0.0098    0.7864    0.9216   -0.0266    1.0000
    0.0392    0.0872   -0.0541   -0.0107    0.0403   -0.2858   -0.0923   -0.2628
```

```
%'Voltage (V)','Current (A)','Active Power (W)','Frecuency (Hz)','Active Energy (KWh)','Power F
%Heat map
% Experimento: ESP32 Temperature
DataFeatures(:,7)=[];
% Based on corrcoef To delete:
% PowerFactor -> alta correlacion con Active Energy (85%), entonces nos
% quedamos con Active Energy
% Voltage, current -> Alta correlacion con Active Power (91% y 86%),
% entonces nos quedfamos Active Power
DataFeatures(:,6)=[];DataFeatures(:,2)=[];DataFeatures(:,1)=[];
% Parametros electricos: Frecuency
DataFeatures(:,2)=[];
%Nos quedamos con estas variables: 'Active Power (W)','Active Energy (KWh)','CPU Consumption (%
```

4 - Regression Learner (Input output Data)

```
training=0.85; %70 Training, 15% Validation, 15% Testing
testing=0.15;
%New Testing adicional...
% NOTA: hacer una prueba sin CPU Consumption (%),RAM Consumption (%) y ver
% si ayudan a mejorar la prediccion...

input=[];output=[];
% inputs: Active Power (W),Active Energy (KWh),CPU Consumption (%),RAM Consumption (%)
input=DataFeatures(1:round(length(DataFeatures)*training)-1,:);
% output: Energía in the following time step
output=DataFeatures(1+1:round(length(DataFeatures)*training),2);
Samples=length(DataFeatures)*0.85-1
```

```
Samples = 2.3022e+04
```

RMSE (Testing): week, day, hour, minute, second

```
% RMSE
```