# %% [markdown]

# ## Energy Disaggregation (Exaplanatory Data Analysis)

# %%

import pandas as pd

import numpy as np

import seaborn as sns

import matplotlib.pyplot as plt

import os

from datetime import datetime

# %% [markdown]

# ### Import datasets

# %%

os.**getcwd**()

# %%

hot\_plate = pd.**read\_csv**(r'/Users/nikossofias/Downloads/Αντιστασιακών φορτία/Energy-Disaggregation/90642-3/Hotplate.csv')

water\_heater = pd.**read\_csv**(r'/Users/nikossofias/Downloads/Αντιστασιακών φορτία/Energy-Disaggregation/90642-3/Total\_house\_\_Water\_heater.csv')

# %%

### Preprocessing DATES

def **combine\_date\_time**(x, y):

return datetime.**combine**(x, y)

def **datetime\_preprocessing**(df):

df['Time (UTC)'] = df['Time (UTC)'].apply(lambda x: datetime.**strptime**(x,'%H:%M:%S:%f').**time**())

df['Date'] = pd.**to\_datetime**(df['Date']).dt.date

df['date\_time'] = list(map(lambda x, y: **combine\_date\_time**(x, y), df['Date'].values.tolist(), df['Time (UTC)'].values.tolist()))

df = df.drop(['Date', 'Time (UTC)'], axis=1)

return df

hot\_plate = **datetime\_preprocessing**(hot\_plate)

water\_heater = **datetime\_preprocessing**(water\_heater)

# %%

water\_heater = water\_heater[['date\_time','Active Power L1 (W)', 'Reactive Power L1 (Var)', 'Active Power L3 (W)']]

hot\_plate = hot\_plate[['date\_time','Active Power L1 (W)']]

# %%

water\_heater.**info**()

# %%

hot\_plate.**info**()

# %%

water\_heater.plot(x='date\_time',subplots=True,figsize=(20,6))

# %%

from turtle import **color**, width

from plotly import graph\_objects as go

fig2 = go.Figure(

data=[

go.Line(

name="Θερμοσύφωνας [W]",

x=water\_heater.date\_time,

y=water\_heater['Active Power L3 (W)'],

legendgroup=1,line=dict(color="black")

),

go.Line(

name="Ενεργός Ισχύς σπιτιού [W]",

x=water\_heater.date\_time,

y=water\_heater['Active Power L1 (W)'],

legendgroup=2,line=dict(color="red")

),

go.Line(

name="Άεργος Ισχύς σπιτιού [Var]",

x=water\_heater.date\_time,

y=water\_heater['Reactive Power L1 (Var)'],

legendgroup=3,line=dict(color="blue")

),

go.Line(

name="Ενεργός Ισχύς Μάτια Κουζίνας [W]",

x=hot\_plate.date\_time,

y=hot\_plate['Active Power L1 (W)'],

legendgroup=4,line=dict(color="green")

),

],

layout=go.Layout(

title="Κατανάλωση Σπιτιού & Θερμοσύφωνα",

yaxis\_title="Power [W]"

)

)

fig2.**update\_layout**(

margin=dict(l=20, r=20, t=30, b=10)

)

fig2.**show**()

# %% [markdown]

# ### Ενεργός & Αεργος Ισχύς EDA

# %% [markdown]

# Πανω στην Ενεργο Ισχύ & αεργο του σπιτιού θα εφαρμοστούν οι κανονες

# %%

water\_heater['Active Power L1 (W)'].plot(title='Total house Active Power [W]')

plt.**grid**()

plt.**figure**()

water\_heater['Active Power L1 (W)'].**hist**(bins=100)

plt.**title**('Histogram Total house Active Power [W]')

**print**(water\_heater['Active Power L1 (W)'].**describe**())

# %%

water\_heater['Reactive Power L1 (Var)'].plot(title='Total house Reactive Power (Var)')

plt.**grid**()

plt.**figure**()

water\_heater['Reactive Power L1 (Var)'].**hist**(bins=100)

plt.**title**('Histogram Total house Reactive Power (Var)')

**print**(water\_heater['Reactive Power L1 (Var)'].**describe**())

# %%

fig2 = go.Figure(

data=[

go.Line(

name="Ενεργός Ισχύς σπιτιού [W]",

x=water\_heater.date\_time,

y=water\_heater['Active Power L1 (W)'],

legendgroup=1,line=dict(color="black")

),

go.Line(

name="1η διαφορά Ενεργός Ισχύς σπιτιού [W]",

x=water\_heater.date\_time,

y=water\_heater['Active Power L1 (W)'].**diff**(),

legendgroup=2,line=dict(color="red")

),

go.Line(

name="Άεργος Ισχύς σπιτιού [Var]",

x=water\_heater.date\_time,

y=water\_heater['Reactive Power L1 (Var)'],

legendgroup=3,line=dict(color="blue")

),

go.Line(

name="1η διαφορά Άεργος Ισχύς σπιτιού [Var]",

x=water\_heater.date\_time,

y=water\_heater['Reactive Power L1 (Var)'].**diff**(),

legendgroup=4,line=dict(color="green")

),

],

layout=go.Layout(

title="Κατανάλωση Σπιτιού",

yaxis\_title="Power [W]"

)

)

fig2.**update\_layout**(

margin=dict(l=20, r=20, t=30, b=10)

)

fig2.**show**()

# %%

# water\_heater['Active Power L1 (W)'].rolling(100).apply(max).dropna().reset\_index(drop=True).plot()

# %% [markdown]

# ## Κανόνας: Απότομες Αλλαγές Active & Reactive

# %%

ap\_diff = water\_heater['Active Power L1 (W)'].**diff**()

rp\_diff = water\_heater['Reactive Power L1 (Var)'].**diff**()

# %%

ap\_diff.**hist**(bins=100)

# %%

ap\_diff\_std = ap\_diff.**describe**()['std']

ap\_diff.**describe**()

# %% [markdown]

# ### Φιλτράρουμε το σήμα της παραγώγου της:

# - Ενεργού Ισχύος με τυπική απόκλιση των 3σ

# - Άεργου Ισχύος με τυπική απόκλιση των 2σ

# %%

# ap\_diff.plot()

# ap\_diff.where((ap\_diff>3\*ap\_diff\_std) | (ap\_diff<-3\*ap\_diff\_std)).plot()#.dropna().index.tolist()

# plt.figure()

# rp\_diff.plot()

# rp\_diff.where((rp\_diff>2\*rp\_diff.describe()['std']) | (rp\_diff<-2\*rp\_diff.describe()['std'])).plot()#.dropna().index.tolist()

# %% [markdown]

# ### Οπτικοποιούμε τα αποτελέσματα

# %%

fig2 = go.Figure(

data=[

go.Line(

name="Ενεργός Ισχύς σπιτιού [W]",

x=water\_heater.date\_time,

y=water\_heater['Active Power L1 (W)'],

legendgroup=1,line=dict(color="black")

),

# go.Line(

# name="1η διαφορά Ενεργός Ισχύς σπιτιού [W]",

# x=water\_heater.date\_time,

# y=water\_heater['Active Power L1 (W)'].diff(),

# legendgroup=2,line=dict(color="red")

# ),

go.Line(

name="Changing Points in Active Power",

x=water\_heater.date\_time,

y=ap\_diff.**where**((ap\_diff>3\*ap\_diff.**describe**()['std']) | (ap\_diff<-3\*ap\_diff.**describe**()['std'])),

legendgroup=3,line=dict(color="blue")

),

go.Line(

name="Changing Points in Rective Power",

x=water\_heater.date\_time,

y=rp\_diff.**where**((rp\_diff>2\*rp\_diff.**describe**()['std']) | (rp\_diff<-2\*rp\_diff.**describe**()['std'])),

legendgroup=4,line=dict(color="green")

),

],

layout=go.Layout(

title="Κατανάλωση Σπιτιού",

yaxis\_title="Power [W]"

)

)

fig2.**update\_layout**(

margin=dict(l=20, r=20, t=30, b=10)

)

fig2.**show**()

# %%

ap\_interest\_points = ap\_diff.**where**((ap\_diff>3\*ap\_diff.**describe**()['std']) | (ap\_diff<-3\*ap\_diff.**describe**()['std'])).**dropna**().index.**tolist**()

rp\_interest\_points = rp\_diff.**where**((rp\_diff>2\*rp\_diff.**describe**()['std']) | (rp\_diff<-2\*rp\_diff.**describe**()['std'])).**dropna**().index.**tolist**()

# %% [markdown]

# ## Κανόνας: ~Σταθερή Κατανάλωση εν λειτουργία φορτίου

# %%

**len**(ap\_interest\_points)

# %%

ap\_interest\_points\_stds = []

idxs\_ap\_interest\_points\_stds = []

for idx in ap\_interest\_points:

# print(idx)

ap\_interest\_points\_stds.**append**(water\_heater.loc[idx+1:idx+5,'Active Power L1 (W)'].**min**())

idxs\_ap\_interest\_points\_stds.**append**(idx)

rp\_interest\_points\_stds = []

idxs\_rp\_interest\_points\_stds = []

for idx in rp\_interest\_points:

rp\_interest\_points\_stds.**append**(water\_heater.loc[idx+1:idx+5,'Reactive Power L1 (Var)'].**min**())

idxs\_rp\_interest\_points\_stds.**append**(idx)

# %%

water\_heater.loc[idxs\_ap\_interest\_points\_stds[100]:idxs\_ap\_interest\_points\_stds[100]+10,'Active Power L1 (W)'].plot()

# %%

plt.**plot**(ap\_interest\_points\_stds)

# %%

plt.**plot**(rp\_interest\_points\_stds)

pd.Series(rp\_interest\_points\_stds).**where**(pd.Series(rp\_interest\_points\_stds)<-100).plot()

# %%

rp\_final\_idxs = []

for special\_idx in pd.Series(rp\_interest\_points\_stds).**where**(pd.Series(rp\_interest\_points\_stds)<-100).**dropna**().index.**tolist**():

rp\_final\_idxs.**append**(idxs\_rp\_interest\_points\_stds[special\_idx])

# %%

special\_rp\_idxs = np.**zeros**(**len**(water\_heater))

special\_rp\_idxs = pd.Series(special\_rp\_idxs).**replace**(0,np.nan)

special\_rp\_idxs[rp\_final\_idxs] = water\_heater.loc[rp\_final\_idxs,'Reactive Power L1 (Var)'].values

# %%

special\_rp\_idxs.**dropna**()

# %% [markdown]

# ### Οπτικοποιούμε τα αποτελέσματα

# %%

fig2 = go.Figure(

data=[

go.Line(

name="Ενεργός Ισχύς σπιτιού [W]",

x=water\_heater.date\_time,

y=water\_heater['Active Power L1 (W)'],

legendgroup=1,line=dict(color="black")

),

go.Scatter(

name="Τελικά Ενδιαφέροντα σημεια Άεργος Ισχύς",

x=water\_heater.date\_time,

y=special\_rp\_idxs,

legendgroup=2,line=dict(color="red")

),

go.Line(

name="Changing Points in Active Power",

x=water\_heater.date\_time,

y=ap\_diff.**where**((ap\_diff>3\*ap\_diff.**describe**()['std']) | (ap\_diff<-3\*ap\_diff.**describe**()['std'])),

legendgroup=3,line=dict(color="blue")

),

go.Line(

name="Changing Points in Rective Power",

x=water\_heater.date\_time,

y=rp\_diff.**where**((rp\_diff>2\*rp\_diff.**describe**()['std']) | (rp\_diff<-2\*rp\_diff.**describe**()['std'])),

legendgroup=4,line=dict(color="green")

),

],

layout=go.Layout(

title="Κατανάλωση Σπιτιού",

yaxis\_title="Power [W]"

)

)

fig2.**update\_layout**(

margin=dict(l=20, r=20, t=30, b=10)

)

fig2.**show**()

# %%

water\_heater['Active Power L1 (W)'].plot()

special\_rp\_idxs.plot()

# %%