

# MACHINE LEARNING (EV)



**For More  
Info :**

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```
In [1]: pip install pandas numpy matplotlib seaborn scikit-learn prophet
```

```
Requirement already satisfied: pandas in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (2.3.3)
Requirement already satisfied: numpy in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (2.3.3)
Requirement already satisfied: matplotlib in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (3.10.7)
Requirement already satisfied: seaborn in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (0.13.2)
Collecting scikit-learn
  Downloading scikit_learn-1.8.0-cp314-cp314-win_amd64.whl.metadata (11 kB)
Collecting prophet
  Downloading prophet-1.3.0-py3-none-win_amd64.whl.metadata (3.6 kB)
Requirement already satisfied: python-dateutil>=2.8.2 in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (from pandas) (2.9.0.post0)
Requirement already satisfied: pytz>=2020.1 in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (from pandas) (2025.2)
Requirement already satisfied: tzdata>=2022.7 in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (from pandas) (2025.2)
Requirement already satisfied: contourpy>=1.0.1 in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (from matplotlib) (1.3.3)
Requirement already satisfied: cycler>=0.10 in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (from matplotlib) (0.12.1)
Requirement already satisfied: fonttools>=4.22.0 in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (from matplotlib) (4.60.1)
Requirement already satisfied: kiwisolver>=1.3.1 in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (from matplotlib) (1.4.9)
Requirement already satisfied: packaging>=20.0 in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (from matplotlib) (25.0)
Requirement already satisfied: pillow>=8 in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (from matplotlib) (11.3.0)
Requirement already satisfied: pyparsing>=3 in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (from matplotlib) (3.2.5)
Requirement already satisfied: scipy>=1.10.0 in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (from scikit-learn) (1.17.0)
Requirement already satisfied: joblib>=1.3.0 in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (from scikit-learn) (1.5.3)
Collecting threadpoolctl>=3.2.0 (from scikit-learn)


```

```
  Downloading threadpoolctl-3.6.0-py3-none-any.whl.metadata (13 kB)
Collecting cmdstanpy>=1.0.4 (from prophet)
  Downloading cmdstanpy-1.3.0-py3-none-any.whl.metadata (4.2 kB)
Collecting holidays<1,>=0.25 (from prophet)
  Downloading holidays-0.90-py3-none-any.whl.metadata (50 kB)
Requirement already satisfied: tqdm>=4.36.1 in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (from prophet) (4.67.3)
Collecting importlib_resources (from prophet)
  Downloading importlib_resources-6.5.2-py3-none-any.whl.metadata (3.9 kB)
Requirement already satisfied: six>=1.5 in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (from python-dateutil>=2.8.2->pandas) (1.17.0)
Collecting stanio<2.0.0,>=0.4.0 (from cmdstanpy>=1.0.4->prophet)
  Downloading stanio-0.5.1-py3-none-any.whl.metadata (1.6 kB)
Requirement already satisfied: colorama in c:\users\dell\appdata\local\programs\python\python314\lib\site-packages (from tqdm>=4.36.1->prophet) (0.4.6)
Downloading scikit_learn-1.8.0-cp314-cp314-win_amd64.whl (8.1 MB)
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Downloading holidays-0.90-py3-none-any.whl (1.4 MB)

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Downloading cmdstanpy-1.3.0-py3-none-any.whl (99 kB)

Downloading stanio-0.5.1-py3-none-any.whl (8.1 kB)

Downloading threadpoolctl-3.6.0-py3-none-any.whl (18 kB)

Downloading importlib\_resources-6.5.2-py3-none-any.whl (37 kB)

Installing collected packages: threadpoolctl, stanio, importlib\_resources, scikit-learn, holidays, cmdstanpy, prophet

```
----- 1/7 [stantio] ----- 2/7
[importlib_resources] ----- 2/7 [importlib_resources] -----
----- 2/7 [importlib_resources] ----- 2/7 [importlib_resources]
----- 3/7 [scikit-learn] ----- 3/7
[scikit-learn] ----- 3/7 [scikit-learn] -----
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```











```
----- 6/7 [prophet] -----  
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---- 6/7 [prophet] ----- 7/7 [prophet]
```

Successfully installed cmdstanpy-1.3.0 holidays-0.90 importlib\_resources-6.

5.2 prophet-1.3.0 scikit-learn-1.8.0 stadio-0.5.1 threadpoolctl-3.6.0

Note: you may need to restart the kernel to use updated packages.

[notice] A new release of pip is available: 25.2 -> 26.0.1

[notice] To update, run: python.exe -m pip install --upgrade pip

In [2]:

```
import pandas as pd  
  
sessions = pd.read_csv("charging_sessions.csv")  
customers = pd.read_csv("customers.csv") districts =  
pd.read_csv("districts.csv")  
  
sessions.head()
```

Out[2]:

|   | session_id | customer_id | station_id | session_start_time | kwh_charged         | cost_     |
|---|------------|-------------|------------|--------------------|---------------------|-----------|
| 0 | S00001     |             | C3806      | 18                 | 2025-10-04 05:42:00 | 46.691971 |
| 1 | S00002     |             | C4931      | 98                 | 2025-10-19 16:12:00 | 39.061716 |
| 2 | S00003     |             | C2250      | 145                | 2025-09-14 15:18:00 | 30.280525 |
| 3 | S00004     |             | C3790      | 165                | 2025-10-06 23:22:00 | 44.577079 |
| 4 | S00005     |             | C4834      | 68                 | 2025-09-26 09:07:00 | 37.998209 |

## Basic Cleaning

In [4]: sessions.drop\_duplicates(inplace=True)  
sessions['start\_time'] = pd.to\_datetime(sessions['session\_start\_time'])  
sessions.isnull().sum()

```
Out[4]: session_id      0  
customer_id       0  
station_id        0  
session_start_time 0  
kwh_charged       0  
cost_per_kwh      0  
total_cost         0  
start_time         0  
dtype: int64
```

## PART A — FORECASTING DEMAND

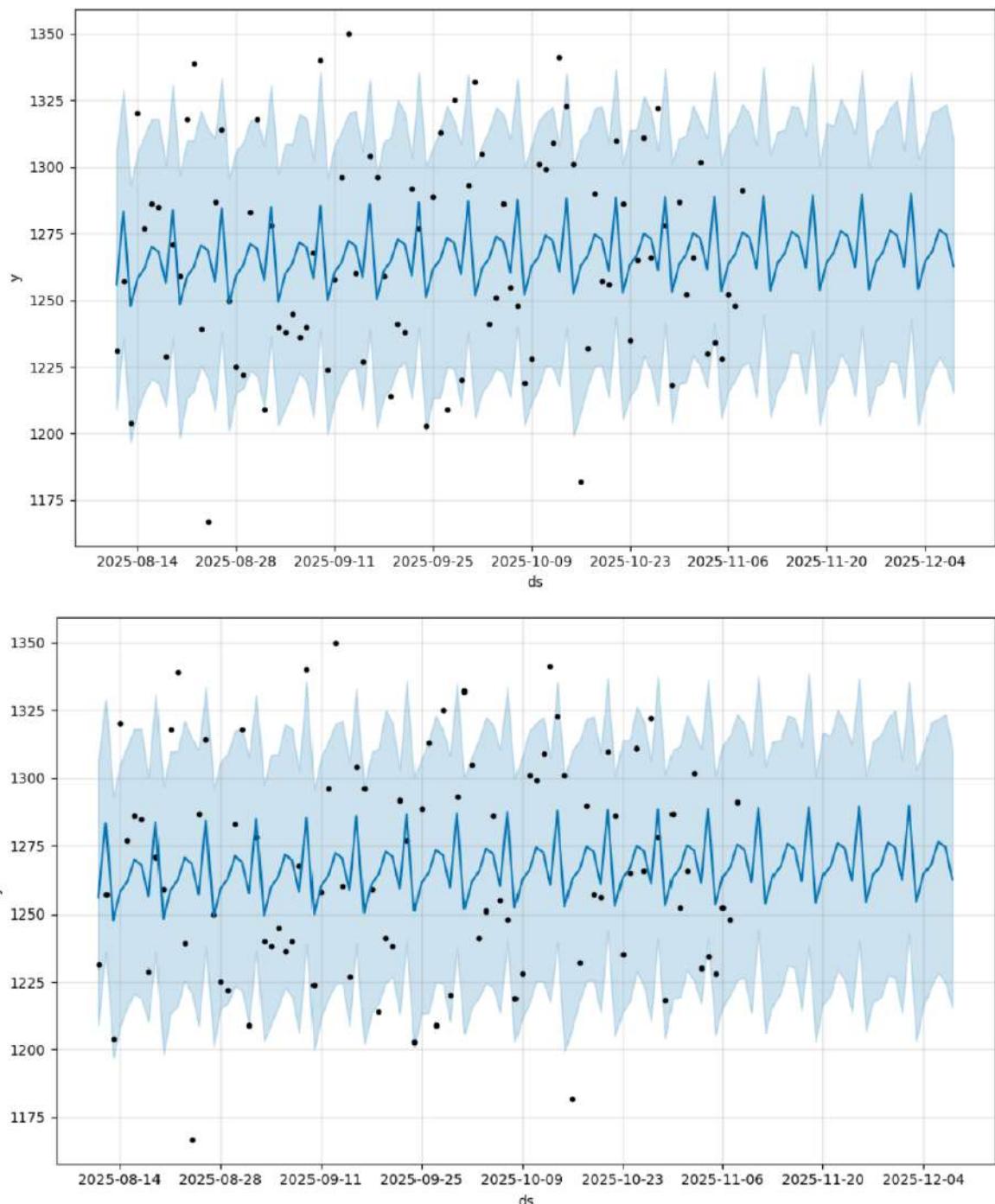
```
In [6]: # Step A1 — Aggregate Daily Demand  
daily = sessions.groupby(  
    sessions['start_time'].dt.date  
)  
.size().reset_index(name='sessions')  
  
daily.columns = ['ds','y']  
daily['ds'] = pd.to_datetime(daily['ds'])  
daily['ds']
```

```
Out[6]: 0    2025-08-11  
1    2025-08-12  
2    2025-08-13  
3    2025-08-14  
4    2025-08-15  
...  
85   2025-11-04  
86   2025-11-05  
87   2025-11-06  
88   2025-11-07  
89   2025-11-08  
Name: ds, Length: 90, dtype: datetime64[ns]
```

```
In [7]: # Step A2 — Train Prophet Model  
from prophet import Prophet  
  
model = Prophet()  
model.fit(daily)  
  
future = model.make_future_dataframe(periods=30)  
forecast = model.predict(future)  
  
model.plot(forecast)
```

```
C:\Users\DELL\AppData\Local\Programs\Python\Python314\Lib\site-packages\tqdm  
\auto.py:21: TqdmWarning: IPProgress not found. Please update jupyter and ipy widgets. See  
https://ipywidgets.readthedocs.io/en/stable/user\_install.html  
from .autonotebook import tqdm as notebook_tqdm  
Importing plotly failed. Interactive plots will not work.  
19:26:54 - cmdstanpy - INFO - Chain [1] start processing  
19:26:56 - cmdstanpy - INFO - Chain [1] done processing
```

Out[7]:



## PART B — REGRESSION (Cost Prediction)

In [12]:

```
#Step B1 — Feature Engineering
sessions['hour'] = sessions['start_time'].dt.hour
X = sessions[['kwh_charged','hour']]
y = sessions['total_cost']
```

In [13]:

```
# Step B2 — Train Model
from sklearn.model_selection import train_test_split
from sklearn.ensemble import RandomForestRegressor
from sklearn.metrics import mean_squared_error

X_train,X_test,y_train,y_test = train_test_split(X,y,test_size=0.2)

model = RandomForestRegressor()
model.fit(X_train,y_train)

pred = model.predict(X_test)
print(mean_squared_error(y_test,pred))
```

5.7576598442473784e-05

## PART C — CLUSTERING

In [16]:

```
#Step C1 — Aggregate Behavior
cust = sessions.groupby('customer_id').agg({
    'kwh_charged':'sum',
    'session_id':'count',
    'total_cost':'sum'
}).reset_index()

cust.columns = ['customer','energy','sessions','spend']
```

In [18]:

```
#Step C2 — Run KMeans
from sklearn.cluster import KMeans

kmeans = KMeans(n_clusters=3)
cust['cluster'] = kmeans.fit_predict(cust[['energy','sessions','spend']])
cust['cluster']
```

Out[18]:

```
0      1
1      1
2      2
3      1
4      1
..
7995   0
7996   2
7997   0
7998   0
7999   0
Name: cluster, Length: 8000, dtype: int32
```

In [ ]:

**THANK  
YOU**