

Case study:

Electricity must be generated when it is consumed. Thus, it is important to keep production and consumption in balance. To keep the system in balance, the system operators use up-regulations (increase production/decrease consumption) and down-regulations (decrease production/increase consumption). The difference between activated volume for down-regulation and up-regulation during a period is called **imbalance**. The imbalance can be positive or negative. If it is positive, it means there is an energy surplus in the electricity system. If it is negative, it means there is an energy deficiency in the electricity system. If it is 0 then it means the system is in balance.

In this case study, your aim is to show a system imbalance direction heuristic forecasts performance.

- 1) Fetch imbalance direction data from EPIAS by using request library of Python between 2022-01-01 and 2022-11-01 where the sample url is

<https://seffalik.epias.com.tr/transparency/service/market/smp?endDate=2022-11-01&startDate=2022-01-01>

The response of this request is in json format as follows:

```
{
  "resultCode": "0",
  "resultDescription": "success",
  "body": {
    "smpList": [
      {
        "date": "2022-01-01T00:00:00.000+0300",
        "price": 525,
        "smpDirection": "YAT",
        "smpDirectionId": 3,
        "nextHour": "2022-01-01T01:00:00.000+0300"
      }
    ]
  }
}
```

Where inside "smpList" there exist system direction (with header smpDirection) data for each hour (with date header). To illustrate, for the above example for 2022-01-01 00:00 system direction is "YAT".

- 2) Suppose that we have the following heuristic rule to forecast system imbalance direction:
"System imbalance direction of hour t is the same as system direction of hour t-3".
 - a) Show the performance of the heuristic in terms of accuracy while considering the whole data.
 - b) Show the performance of the heuristic in terms of the accuracy of each hour.
 - c) Show the performance of the heuristic in terms of accuracy of each hour of each month.
 - d) What is your comment on the performance of this heuristic?

- 3) Now suppose that we have the following heuristic rule to forecast system imbalance direction:
“System imbalance direction of on day d at hour t is the same as system direction of day d-7 at hour t”.
- Show the performance of the heuristic in terms of accuracy while considering the whole data.
 - Show the performance of the heuristic in terms of the accuracy of each hour.
 - Show the performance of the heuristic in terms of accuracy of each hour of each month.
 - What is your comment on the performance of this heuristic?
 - Compare the results of this heuristic with the previous one, and use a t-test to show whether there is a significant performance difference between the two heuristics.
 - What is your suggestion about using these heuristics?

Notes:

- We want from you to do this analysis using **python** and show your results with the appropriate **graphs**.
- If you cannot do the first step, you can download the data from the following web site and use it in your analysis. <https://seffaflik.epias.com.tr/transparency/piyasalar/dgp/sistem-yonu.xhtml>

Please prepare a report and send your report and your python code to do this case study.

Evaluation criteria:

- Coding performance
- Analysis results
- Analytical thinking