Take Home Assessment

Background

Dispatch Algorithm

The UK electricity market functions by having all prospective generators bid in an hourly pay-as-clear auction ran by the system operator (SO), the entity that is responsible for balancing out supply and demand.

Ahead of every hour, the generators assess their variable costs for producing electricity and inform the SO of the price at which they are willing to generate 1MWh of electrical energy. This bid should be set such that their operation would be breaking even.

While green energy generators (wind and solar in this case) have negligible costs (assume them to be £0 per MWh produced for this task), gas plants have their breakeven highly correlated to the price of the commodity they are burning and the efficiencies of the plants themselves (assume their costs only include buying the amount of burnt fuel for that hour).

The nationwide price of electricity for the hour is what is known as the “marginal price” - the lowest bid for which dispatching all generators with a lower or equal bid fills up the demand for the hour.

Load Factors

These are a percentage measure of the available (useful) capacity that is ready to be dispatched for any given hour for a green generator. Some hours are less windy/sunny than others, and that information is encoded in these timeseries. Assume these are known to their respective generators ahead of the time.

Explanation of the Data

You have been provided a data.xlsx file containing multiple tabs (tables) worth of data needed to complete this assessment. Whilst additional research may help you to understand the context, the data is sufficient for you to complete the task.

Data Tables

Table 1 - windplants

Data Items	Descriptions
name	The name of the wind plant
capacity	The maximum capacity of the wind plant (MW)

Table 2 - wind_loadfactors

Data Items	Descriptions
hour	The hour index, matched across tables, starting on an arbitrary day’s midnight (hour 1) and incrementing each passing hour.
wind1	The load factor for the wind1 plant for the given hour (value between 0 and 1)
wind2	The load factor for the wind2 plant for the given hour (value between 0 and 1)
wind3	The load factor for the wind3 plant for the given hour (value between 0 and 1)
wind4	The load factor for the wind4 plant for the given hour (value between 0 and 1)
wind5	The load factor for the wind5 plant for the given hour (value between 0 and 1)
wind6	The load factor for the wind6 plant for the given hour (0 to 1)

Table 3 - solarplants

Data Items	Descriptions
name	The name of the solar plant
capacity	The maximum capacity of the solar plant (MW)

Table 4 - solar_loadfactors

Data Items	Descriptions
hour	The hour index, matched across tables, starting on an arbitrary day's midnight (hour 1) and incrementing each passing hour.
solar1	The load factor for the solar1 plant for the given hour (value between 0 and 1)
solar2	The load factor for the solar2 plant for the given hour (value between 0 and 1)
solar3	The load factor for the solar3 plant for the given hour (value between 0 and 1)
solar4	The load factor for the solar4 plant for the given hour (value between 0 and 1)
solar5	The load factor for the solar5 plant for the given hour (value between 0 and 1)
solar6	The load factor for the solar6 plant for the given hour (value between 0 and 1)
solar7	The load factor for the solar7 plant for the given hour (value between 0 and 1)
solar8	The load factor for the solar8 plant for the given hour (value between 0 and 1)
solar9	The load factor for the solar9 plant for the given hour (value between 0 and 1)
solar10	The load factor for the solar10 plant for the given hour (value between 0 and 1)

Table 5 - gasplants

Data Items	Descriptions
name	The name of the gas plant
capacity	The maximum capacity of the gas plant (MW)
efficiency	Efficiency of the gas plant is the amount of electrical energy produced per unit of gas energy consumed (dimensionless)

Table 6 - demand

Data Items	Descriptions
hour	The hour index, matched across tables, starting on an arbitrary day's midnight (hour 1) and incrementing each passing hour.
demand	Nationwide electricity demand for the given hour (MWh) known in advance of the hourly auction.

Table 7 - gas_prices

Data Items	Descriptions
hour	The hour index, matched across tables, starting on an arbitrary day's midnight (hour 1) and incrementing each passing hour.
price	The price of gas for the given hour in pence per Therm (GBp/Thm) (1 MWh = 1 Therm * 34.121)

The Task

The purpose of this test is to evaluate your technical skills, design skills and ability to interpret requirements.

Write a Python program that would simulate the auction process to compute the price of electricity in £/MWh for every hour in the data. By looking at the resulting electricity generation, provide a breakdown of the mix of different technologies (wind, solar, gas) that have been dispatched every hour.

You have 7 days to complete this task. Please send us either a link to a repo with your work or attach the files through email by the deadline.