Data Generation Procedure for Electricity Day Ahead Markets

Sinan Yörükoğlu[a,*], Zeynep Müge Avşar[b], Bora Kat[c]

[a] *AF-Mercados EMI, Ankara, Turkey*

[b] *Department of Industrial Engineering, Middle East Technical University, Ankara, Turkey*

[c] *The Scientific and Technological Research Council of Turkey, Ankara, Turkey*

This document is prepared for the purpose of providing a general description of data generation procedure developed for Turkish electricity Day Ahead Market. This procedure can be easily modified for creating bidding data of any day ahead market that involves hourly, block and flexible bids. The below steps are followed when hourly bids are generated, with the emphasis on demand bids for clarification purposes.

1. **Generate unique price levels,**

   i. *Generate 500 price levels using* $Weibull(200, 1.5)$ *distribution,*
   We assume a right skewed distribution of hourly bid prices.

   ii. *Round all values to the nearest integer,*
   Generally, step-down of an hourly demand bid quantity is observed at price level changes where the 'different-quantity' price level is just 0.01 TL lower or higher than the previous price level. This will be taken into consideration in the coming steps.

   iii. *With a probability of 50%, round the generated price levels up to the nearest multiple of five,*

   iv. *Remove duplicate price levels,*
   When the prices are rounded, it very likely that we observe the same price mutliple times. With this step, we obtain unique prices.

   v. *Sort the price levels in ascending order,*
   At this point, we have around 250 unique price levels that are multiple of 5.

2. **Generate hourly demand bids,**

Type a) Constant demand bids;
These bids consist of only two price levels, 0 and $2,000$ TL, which are respectively the lower and upper limits for hourly bid price in the Turkish DAM. These kind of bids are largely observed in practice to the extent we know.

i. *Generate 75 constant bid quantities, coming from the* $Weibull(200, 0.5)$ *distribution,*

Type b) Regular demand bids;
These bids have more than two price levels and at least two distinct quantity values attached to different price levels.

i. *Generate 50 maximum bid quantities, coming from the* $Weibull(500, 0.5)$ *distribution,*
This is the maximum amount of electricity that is estimated to be demanded by an hourly demand bid.

ii. *With probability 20%, assign a non-zero quantity at price level* $2,000$ *TL,*
In most cases, an hourly demand bid has 0 MWh at the highest price level. A smaller number of them will have a positive quantity, meaning that a certain amound of electricity will be demanded no matter what the MCP is.

iii. *Assign the number of discrete quantity jumps in a bid,*
With probability 60%, there is one jump of quantity (two distinct quantities); with 20%, there is two jumps (three distinct quantities); with 10%, there is three quantity jumps; with 5% there is four jumps; and with 5%, there is five quantity jumps in the bid.

iv. *Randomly, but in an ascending order, assign price levels to the distinct quantity levels,*
For each quantity jump, we assign a different price level.

- With probability $^2/_3$, create an additional price level, which is 1 Kuruş (0.01 TL) higher than the previous one. The quantity jump will be at this level, which is frequently observed in real cases.

v. *Assign discrete quantity values to the distinct price levels,*
Starting with the maximum bid quantity (generated in

Step 2.b.i) at price level 0, we decrease the bid quantity by a random percentage of the quantity at the previous price level. This is done up to the price level $2,000$ TL, where the quantity is either 0 or or positive number, depending on the outcome of Step 2.b.ii.

3. **Generate hourly supply bids,**
   A very similar approach to demand bids is assumed to generate hourly supply bids.

The procedure to create block bids is summarized next.

1. **Generate supply and demand block bids,**
   There is on the average 75 demand and 75 supply block bids submitted in a day.

2. **Randomly assign the number of hours a block bid is placed, between 4 and 24,**

3. **Determine the starting period of the block bid, based on the length of its validity time,**

4. **Assign the price parameter, using Normal distribution,**

   - The mean and standard deviation of the normal distribution comes from the daily mean and standard deviation of the MCPs calculated by considering only hourly bids generated. This is done to increase the possibility of obtaining a feasible solution, as very extreme block bid prices may cause infeasibility.
   - The supply block bid price is chosen by the inverse probability between 0 and 60%, while demand bid price is calculated as the difference between the inverse probability value of 60% and a randomly determined inverse probability value between 0 and 60%.

5. **Assign the quantity of the bid, between 0 and 5000 MWh, where the quantity value is a multiple of 50.**

In order to generate flexible bids, the last two steps of the procedure for block bids is followed, which are related to the price and quantity components.