ECEN 460 Lab 7, Spring 2025
Electricity Market Auctions

Objective

Gain experience and insights on the use of auctions for dispatching electric generation.

Background

This lab explores how auctions are used to dispatch electricity markets. In the lab you will be one of small number of electric generator owners selling electricity into an auction-based market in which there is a single buyer called the Independent System Operator (ISO). Hence this is similar to the auctions run by entities such as ERCOT or MISO. The other generator owners will be your fellow classmates.

The lab is organized into several scenarios, and each scenario consists of a sequence of trading periods where each period is assumed to be one hour. During each period the ISO needs to buy a certain amount of electricity, and you will be responsible for trying to sell electricity from your generation to help meet the ISO's requirements. Each student has an identical generation portfolio of five generators with varying maximum capacities and marginal costs; the total capacity for each student is 100 MW. Your hourly cost to supply electricity from each generator is just its output (in MW) multiplied by its marginal cost (in $/MWh).

During each period you must decide the offer price for each of your generators, and then you will submit these offers to the ISO. Once all the offers have been submitted, the ISO will perform an auction to determine which generators get selected to run, which do not run, and what is the market clearing price (in $/MWh). In this lab the ISO will sequentially buy generation based on the offers, starting with the lowest offer and continuing until its MW load is met. The assumption here is that there are no transmission system constraints so the location of your generators in the grid does not matter. Your goal in this lab is to maximize your profit.

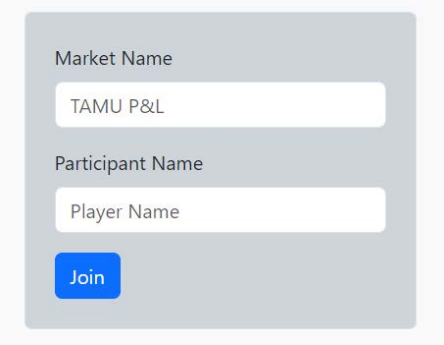
In this lab we will be considering two scenarios for how you get paid for your generation. The first is last accepted offer (LAO) in which the amount you get paid per MW for each of your generators is the value of the LAO. That is, the highest offer that was accepted. This would correspond to the bus locational marginal price (LMP). The second is the pay as offer (PAO) approach in which the amount you get paid per MW is whatever you offer. Your profit is then your income minus your cost. Hence generators that had high offers that were not accepted have no income and no cost, and therefore zero profit.

The only market information you will receive during this lab is 1) the total MW load the ISO must buy for that period, and 2) at the end of the period you will receive the market clearing price (or LAO) and information about how much of your generation was accepted and information about your profit.

During this lab it is extremely important that you do not talk with any of your fellow market participants about anything related to the electricity market such as your upcoming offers or profit. In an actual electricity market this could be considered illegal collusion!

Joining the Market Simulator

TAMU Energy Market Simulator Link: https://people.tamu.edu/~wyattluke.lowery/



1. Navigate to the TAMU Energy Market Simulator using the link above.
2. Enter your **Participant Name** and the **Market Name** provided by your TA.
3. Join the Market and wait for further instructions.

Simulation Procedure

Once all the students have joined, the TA will start the scenario, which will consist of a series of trading periods. First the TA will conduct a short practice game, with three or four trading periods in which all generators that are selected to generate electricity will be paid the $/MWh associated with the last accepted offer (LAO). Note that the last offer accepted is usually only partially accepted since the total of the accepted offers must exactly meet the system load. In the case of identical offers equal to the LAO price (say multiple students submit $30/MWh) the market selects one randomly. Once the TA has started the scenario you will see in the lower table the load for each period that the ISO will need to procure. The load will vary from period to period. You will also see blank spaces for the market clearing price (which is the LAO) and your specific results, which will fill in as the market proceeds. **You will not see results for the other students, and you should not attempt to obtain this information.** You should then enter in your five offers into the Offer fields. This is shown in the figure on the next page. Note, for this lab the offers are limited to being between $ 0/MWh and $ 200/MWh.

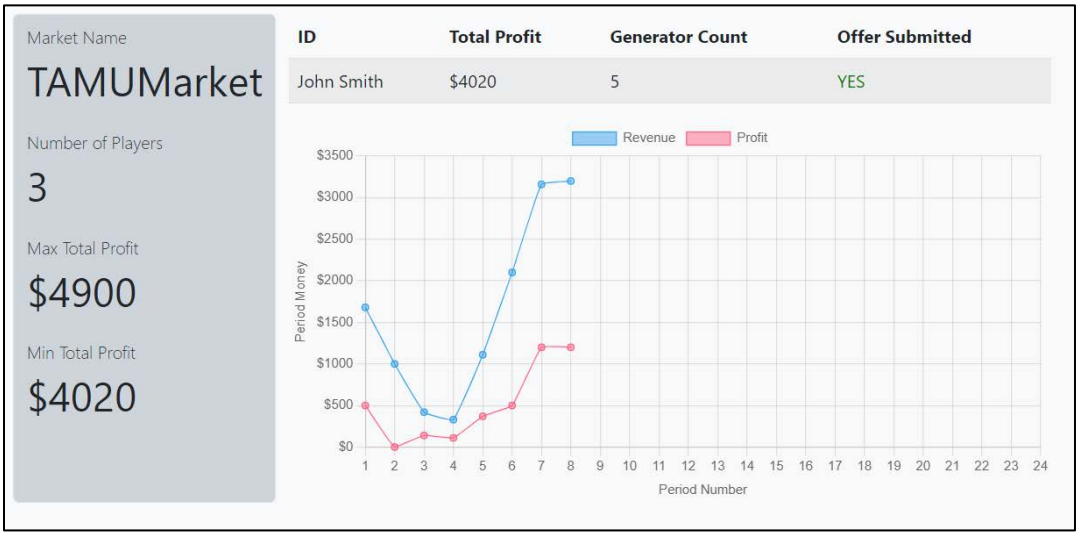


Figure 1: Market Status View

Once you have selected all five of your offers click on the **Submit Offers** button. Once you submit your offers they cannot be changed. After this the **Submit Offers for Period** button will be disabled, and you'll need to wait until all the offers from the other students are submitted. Once they are submitted the TA will move on to the next period.

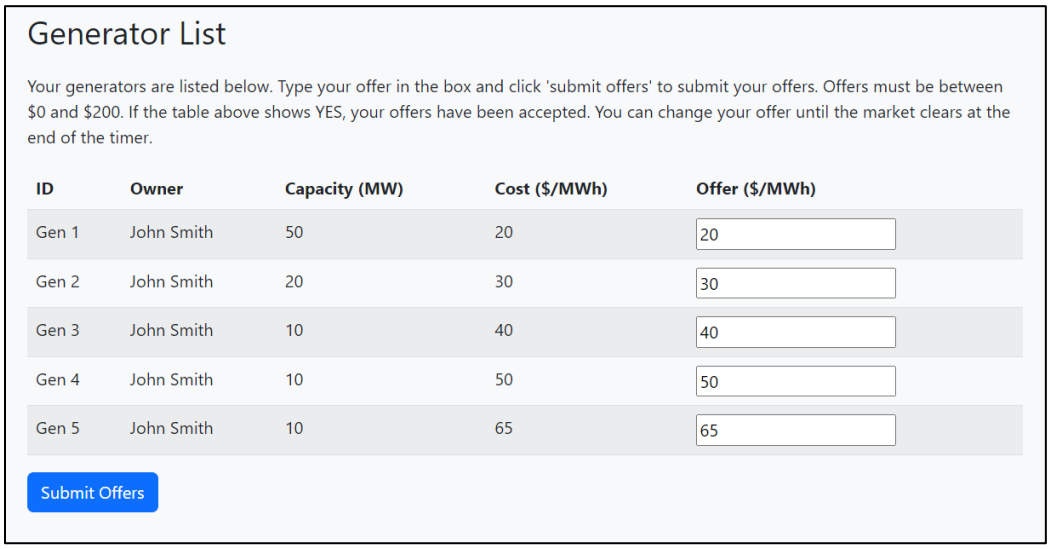


Figure 2: Market Offer Input and Submission

The above process repeats until the end of the practice scenario. At that point the TA will provide an anonymous list of the total profits for all the players. This will give you a feel for how well you are doing relative to the others in the lab.

The data for the simulation can always be seen in the table at the bottom of the page. When the simulation has finished, you will need to download the data to use during the lab report. There is a **'Download CSV'** button at the bottom of the table.

Period List

Number	Load	Marginal Price ($/MWh)	John Smith Revenue	John Smith Costs	John Smith Profit	John Smith Money	Gen 1 Offer	Gen 1 MW	Gen 2 Offer	Gen 2 MW
1	156	30	1680	1180	500	500	20	50	30	6
2	141	20	1000	1000	0	500	20	50	30	0
3	134	30	420	280	140	640	30	14	30	0
4	131	30	330	220	110	750	30	11	30	0
5	157	30	1110	740	370	1120	30	37	30	0
6	190	30	2100	1600	500	1620	30	50	30	20
7	219	40	3160	1960	1200	2820	30	50	30	20

Last Accepted Offer (LAO) and Pay as Offer (PAO) Simulation

1. The first real scenario is also one in which all accepted generators are paid the LAO, except this one will be 15 periods long. In order to create the correct incentives for you to maximize your profit, ideally you would be paid a portion of your profit. However, we cannot do that. Rather, we will be offering bonus points on the lab report grade if you do well in your market. So, consider your strategy as you go through the trading period! Also be sure to record your results from each period. This will help you both in determining your strategy for future periods and should be included in your lab writeup.

2. The last regular scenario functions similarly to the previous one, except generators are paid based upon what they offer into the market (pay as offer or PAO). So if you offer $ 0/MWh for your 50 MW generator, and the LAO is $ 100/MWh, you will be paid zero! Again, this scenario will be 15 periods long, and more bonus points will be awarded.

Report:

You will receive 5 bonus points on your report if you finish in the top 50% of your market, and an additional 5 bonus points if you finish at the top. You can earn bonus points for both the LAO and the PAO round; hence your maximum bonus is 20 points.

In writing the report, provide a thorough summary of your results from both the LAO and PAO 15 period rounds. Answer each question below in detail:

1. What was your strategy in submitting your offers?
2. How did your strategy work relative to others in the class? If you did well, what was the difference? If you did not do as well, what other strategy might have been better?
3. For the LAO round, how did the clearing price vary with the total load?
4. For the LAO round, in which periods were you a price-taker, and in which periods were you a price-setter? How do you know?
5. How did your strategy differ in the PAO round compared to the LAO round?
6. What is better or worse about the PAO vs the LAO market, from the participant's point of view? From the market's point of view?
7. What would have happened to the market results if, say, 4 out of 6 of the participants communicated with each other and colluded?