

ECE 364 Project Option #3: Virtual bidding in NYISO's markets

Spring 2025

1 Project Background

This project focuses on virtual trading in New York ISO's¹ electricity markets using historical Day-Ahead (DA) and Real-Time (RT) price data. Students will develop a classification model and trading strategy to identify profitable trading opportunities. For this project, we focus on predicting when the Day-Ahead (DA) price will be lower than the Real-Time (RT) price and making a profit on the difference. A quick overview of how the electricity market works is given in §2, but feel free to use online resources to get a better understanding.

You are provided the following dataset with six .csv files:

- Load Forecasts (Table 1): DAM_NYISO_LoadForecast_2015.csv
- DA Prices (Table 2): DAM_NYISO_Zonal_LBMP_2015.csv, DAM_NYISO_Zonal_LBMP_2016.csv
- RT Prices (Table 3): RTM_NYISO_Zonal_LBMP_2015.csv, RTM_NYISO_Zonal_LBMP_2016.csv

id	Eastern Date Hour	Zone Name	DAM Forecast Load	GMT Start Hour
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Table 1. DAM_NYISO_LoadForecast_%YEAR.csv Headers

id	Eastern Date Hour	Zone Name	Zone PTID	DAM Zonal LBMP	DAM Zonal Losses	DAM Zonal Congestion	DAM Zonal Price Version
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Table 2. DAM_NYISO_Zonal_LBMP_%YEAR.csv Headers

id	Eastern Date Hour	Zone Name	Zone PTID	TWI Zonal LBMP	TWI Zonal Losses	TWI Zonal Congestion	TWI Zonal Price Version
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Table 3. RTM_NYISO_Zonal_LBMP_%YEAR.csv Headers

Basic explanation for Table 1, Table 2, and Table 3:

1. DAM Forecast Load is the forecasted load for the next day.
2. DAM/TWI Zonal LBMP are the DA and RT prices for each zone respectively.
3. List of zones: CAPITL, CENTRL, DUNWOD, GENESE, HUD VL, LONGIL, MHK VL, MILLWD, N.Y.C., NORTH, WEST

¹ <https://www.nyiso.com>

The goal is to generate daily trading signals (buy/no action) and bid prices for 264 zone-hour combinations (11 zones \times 24 hours) with the following restrictions:

- Daily budget of \$250,000
- The number of parameters for your model must not exceed 15 million
- Train only on the 2015 data. 2016 data is used as the test dataset.

The output of your model and trading algorithm should be a .csv file with headers seen in Table 4.

id	Eastern Date Hour	Zone Name	Zone PTID	DA Lower	Bid Price
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Table 4. output.csv Headers

1. Eastern Date Hour, Zone Name, Zone PTID are the same as the files given in Table 2. and Table 3.
2. DA Lower is either a 1 (indicating that your model predicts that the current DA price will be lower than its corresponding RT price, meaning that a trade is viable), or 0 (current DA price will be higher than its corresponding RT price and no trade is viable).
3. Bid Price is the price your trading algorithm recommends when a trade opportunity is predicted (DA Lower = 1). If DA Lower = 1, then Bid Price needs to be a value representing the maximum price you are willing to pay in the DA market for that option.
4. Profit from your output is calculated as follows: For each zone and time: Profit = (RT Price – Bid Price) but only when all of the following conditions hold:
 - (a) Your model predicted a trade DA Lower = 1 (profit viable).
 - (b) The actual DA price is lower than the RT price.
 - (c) The bid clears (i.e., Bid Price > actual DA price).
 Otherwise, profit is zero. Note that the daily budget for all bids in a day is \$250,000. The budget does not carry over to the next day.

2 How the Electricity Market Works: NYISO’s DA and RT Markets

The New York Independent System Operator (NYISO) manages the electricity grid and operates two key markets: the Day-Ahead (DA) Market and the Real-Time (RT) Market. These markets balance supply and demand while ensuring grid reliability. Below is a quick breakdown to help you get started. Note: for project purposes, there are simplifications we have made explained above. Below is strictly how the actual market works.

1. Day-Ahead (DA) Market:
 - When: Participants submit bids 24 hours before electricity is needed.
 - Purpose: Forecast demand and schedule generation/resources.
 - Process:
 - (a) Bids/Offers: Generators submit the price they’re willing to supply power, and buyers (utilities, traders) submit bids.
 - (b) Clearing: NYISO matches supply and demand to set hourly zonal prices.
 - (c) Commitment: Generators are financially obligated to deliver power at the cleared price.
 - Virtual Bidding: Traders can place financial bids (no physical generation) to profit from price differences between DA and RT markets.

2. Real-Time (RT) Market:
 - When: Adjusts every 5 minutes based on actual grid conditions.
 - Purpose: Address real-time imbalances in supply/demand.
 - Process:
 - (a) Continuous Updates: Prices fluctuate based on unexpected changes (e.g., outages, weather).
 - (b) Settlement: Final hourly RT prices are averages of 5-minute intervals.
 - (c) Physical Delivery: Generators adjust output to meet real-time demand.
3. Locational Marginal Pricing (LMP)
 - Definition: The price of electricity at a specific location (zone) and time, reflecting:
 - (a) Energy Cost: Base cost of generation.
 - (b) Congestion Cost: Transmission limits between zones.
 - (c) Losses: Energy lost during transmission.
 - Example: If a transmission line is congested, LMPs rise in high-demand zones (e.g., NYC).
4. Virtual Bidding
 - Mechanism:
 - (a) Buy DA, Sell RT: Profit if DA price < RT price.
 - (b) Sell DA, Buy RT: Profit if DA price > RT price.
 - Impact:
 - (a) Reduces price gaps between DA and RT markets.
 - (b) Increases market efficiency by incorporating financial participants.

3 Deliverables

The following are the deliverables of this project:

- A prediction model and trading algorithm to generate trading signals.
- The number of parameters in the model must not exceed 15 million.
- You are free to use any publicly available model (pre-trained or otherwise) but it is not a requirement.
- You should be constructing the feature and labels from the given data for training purposes, as well as the training and testing pipeline.

4 Submission

1. Submit all your code, including pipeline, training and evaluation, as a **.zip** file.
2. Submit prediction file in kaggle.
3. Submit a 2-page report (1-inch margin, 12-point font) and include
 - Your approach, model, algorithm, and any other design choice.
 - Hyperparameters that you used for training.
 - Training and test results.
 - Any other interesting details about the approach or model.