Electricity Provisioning based on Demand Prediction

The goal of this homework is to test the performance of different electricity provisioning algorithms based on the demand predictions you obtained in Homework 1.

Continue to use the separate datasets for 10 users that contain the load demand (in kW) for each 15-minute interval that covers 1 year (12/1/2014 – 11/30/2015) given in Homework 1. Your objective is to utilize existing provisioning algorithms (online gradient descent, online balanced descent, receding horizon control, commitment horizon control) to provision electricity for each user.

The performance is measured by the following objective function

$$\sum_{t=1}^{T} p(t)x(t) + a * \max\{0, y(t) - x(t)\} + b|x(t) - x(t-1)|$$

You need to decide $x(t)$ based on historical information and predictions of future demands. We assume $x(0) = 0$.

Here $p(t)$ is the electricity price at time t, which you can assume as a constant \$0.40/kWh. Optional: you can use some real-time pricing, e.g., https://www.iso-ne.com/isoexpress/web/reports/pricing.

We assume $a = b = \$4/kwh$, and you need to vary them to see the impacts.

You can use the prediction of $y(t)$, which is the output from your Homework 1.

Required tasks:

- Solve the offline optimization problem, e.g., using tools CVX in Matlab or Python.
- Try online gradient descent (with different step size), online balanced descent, receding horizon control, commitment horizon control (with different commitment levels) based on the predictions from at least two prediction algorithms for the default value of a and b.
- Compare the cost to that of the offline static and dynamic solutions.
- For the best combination of control algorithm and prediction algorithm, vary a and b to see the impacts.
- Try at least two algorithm selection to see if their performance.

Bonus task:

- Try to develop better control algorithm or algorithm selection.

In your report, please discuss in details about each task.