EN.553.753
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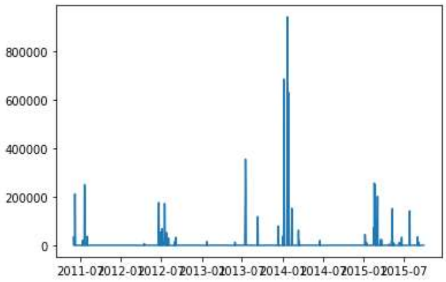
Project 3[Detail is in the coding provided]

After sorting out the data and creating an hourly headroom data frame. We had three stages of thinking processes.

Stage 1 (just to get a sense of feeling): We decided to take off the minhour=16 constraint, not consider turn on/off by hour, instead of by day. Then filter the revenue, if the next day's profit is positive, then we will stay on. If the next day's profit is negative, we will turn it off. [The 10k turn on cost is considered when calculating the profit]

```
9919193.883800004
```

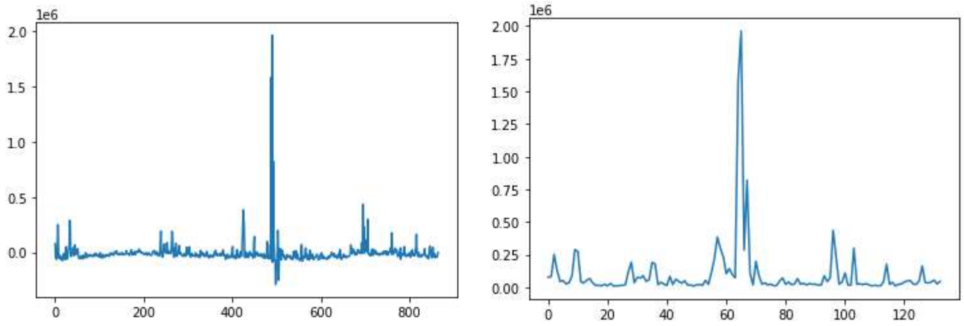


Therefore, if we robustly turn on and off by daily profit, we can at least secure $10m profit.

Now, we can add in the 16 minimum hour constraint and the profit should improve upon $9.92 mil.

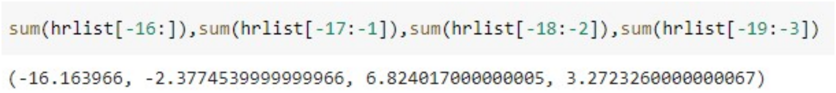
Stage 2: Instead of using the headroom data frame, we create a headroom list with a length of 1583*24, since we don't really care about exactly when to turn on and off, as long as the time periods are connected.

After taking out all the possible periods with a positive hourly headroom and setting up a long and tedious algorithm [detail is in the .ipynb file], we have successfully increased the profit by $2m, which adds to $11.94m in total.



The left graph represents the return of all possible periods with at least one positive hourly headroom. The right graph represents all profitable periods.

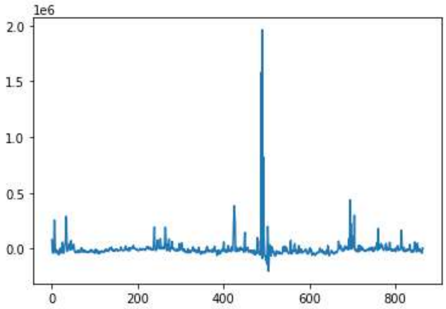
Stage 3: Stage 2 finds the profit in a very straightforward way, but it's not the most optimal way.

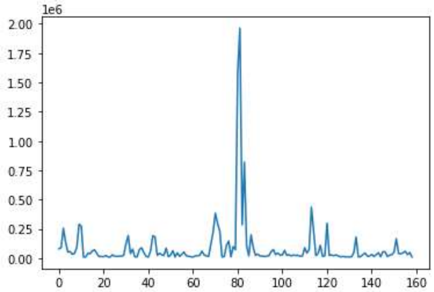


```
sum(hrlist[-16:]),sum(hrlist[-17:-1]),sum(hrlist[-18:-2]),sum(hrlist[-19:-3])
```

```
(-16.163966, -2.3774539999999966, 6.824017000000005, 3.2723260000000067)
```

As we can see in the screenshot above, there is still room to improve our profit by shifting or extending the "ON" period to escape from a heavier loss and use a lighter loss instead. Moreover, we created an algorithm to have our code check whether it's more optimal to connect multiple periods or to split them to avoid some losses.





By doing so, we can increase the profit by $385k to $12.33m.

In the end, we think there is still room for development. Because in our code, if we encounter something like [-2,-20,[-2,10,20,30,-9,-6,-100,-10]], our code can only shift 1 hour at a time and would not try to escape from -100, because -10>-20. But it would take a tremendous amount of time and effort to write code like this, it wouldn't be worth it since we think the return afterward would only be increased by a bit.