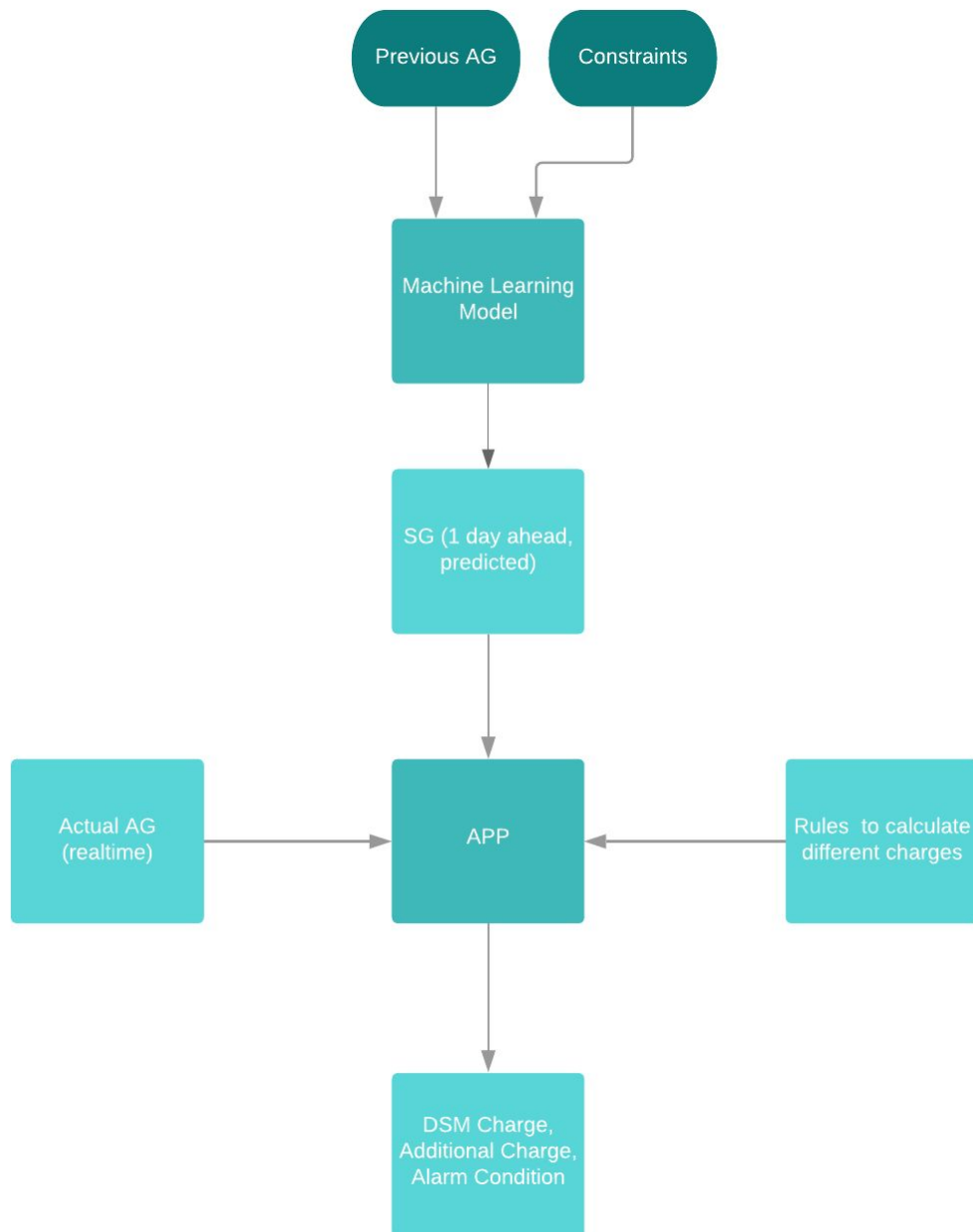


Objective

We are using the past data of actual generation (AG) and making a suitable prediction for scheduled generation (SG) values for the next day.

This is done so that we can match the SG and AG values as closely as possible and, consequently, minimize the losses.



Procedure

Deviation for each time block is calculated. If the deviation has the same sign for more than 12 blocks, we raise alarm.

In the 13th time block, the offender has two options:

1. Either change the sign of deviation at least once by the 13th time block, or
2. Remain in the range of ± 20 MW of schedule.

For each violation, an additional charge of 10% of the DSM charge of the time block is payable/receivable.

Additional Constraints:

1. Charge for deviation for generating station cannot exceed 303.04 p/KWh

I) Conditions for DSM charge and Additional charge:

As per the rules, over-drawal by the buyer and under-injection by the seller are payable. On the contrary, under-drawal by the buyer and over-injection by the seller are receivable.

These are subjected to the following constraints:

1. Charge for under-drawal by the buyer in excess of (12% of the scheduled or 150 MW, whichever is less), shall be zero i.e. if the buyer under-draws within (12% of the scheduled or 150 MW, whichever is less), he should receive an incentive.
2. Charge for over-injection by the seller in excess of (12% of the scheduled or 150 MW, whichever is less), shall be zero i.e. if the seller over-injects within (12% of the scheduled or 150 MW, whichever is less), he should receive an incentive.

Additionally, the following must hold:

1. over-drawal/under-drawal by the buyer cannot exceed (12% of the scheduled or 150 MW, whichever is less) when frequency ≥ 49.70 Hz.
 - a. No overdrawal is permitted when frequency < 49.70 Hz.
2. under-injection/over-injection by the seller cannot exceed (12% of the scheduled or 150 MW, whichever is less) when frequency ≥ 49.70 Hz.
 - a. No under-injection is permitted when frequency < 49.70 Hz.
 - b. No over-injection is permitted when frequency > 50.10 Hz.
3. Drawal prior to COD is exempted additional charge.

If the aforesaid limits are violated, the additional charges applicable are as per TABLE-A and TABLE-B under 7.(3) of Notification 93 of CERC dated 6th January 2014.

II) Calculations for DSM charge and additional charge

The charges for the deviations shall be worked out on the average frequency of a time block at the rates specified in the table under (5) of the aforesaid notification.

1. Additional charge for over-drawal/under-injection when frequency $\geq 50.10\text{Hz}$ are the same as for $50\text{Hz} < \text{frequency} < 50.01\text{Hz}$ under the same table.
2. Additional charge for over-drawal/under-injection when frequency $< 49.70\text{Hz}$ are equivalent to 100% of the charge of deviation of 824.04 p/KWh.
3. When violation of 1 of I) occurs, additional charges are equal to the % charge for deviation corresponding to the frequency table.
4. When frequency $< 49.70\text{ Hz}$, additional charge are equal to a percentage of the charge for deviation.
5. Under-injection in violation of 2 of I), the additional charge is either equal to a % of the charge for deviation or the cap rate or both.

1. When grid frequency $\geq 49.70\text{Hz}$

- A. When Dtb i.e. Deviation from schedule in a time block in MW is less than $(+/-)12\%$ of the schedule in MW or 150 MW whichever is lower in each time block, Dtb to be payable by the regional entity at normal Charges for Deviation;
- B. When Dtb i.e. Deviation from schedule in a time block in MW is more than $(+/-)12\%$ of the schedule in MW or 150 MW whichever is lower in each time block
 - a. $D_{tb} = D_0 + D_{12/150}$
Where
 $D_0 = (+/-)12\%$ of Scheduled Generation (SG) or 150 MW whichever is lower,
 $D_{12/150} = \text{Deviation in excess of } (+/-)12\% \text{ of the SG or 150 MW, whichever is lower in each time block}$
 - b. $D_{12/150} = D_{tb} - D_0$
 - c. The Charges for Deviation corresponding to D_{tb} shall be payable by the regional entity at normal Charges of Deviation

2. When the grid frequency $< 49.70\text{Hz}$

The charges for deviation corresponding to Dtb shall be payable by the regional entity at 1648.08 Paise/kWh including additional charges for the deviation payable by the regional entity at 824.04 Paise/kWh.

How we will proceed?

1. We shall collect data for the past AG values, which will act as a training dataset to predict the SG values.
2. We will represent this data on a scatter plot against time.
3. On the basis of this plot, we will predict the SG values of one day ahead.
4. On the same plot, we will also plot the real-time AG values that we receive from the meters, and consequently, calculate various parameters such as sign of DSM, charges for deviation, additional charge, and BEF (= ACP/5).

Doubts:

We're not clear with the use of ACP values and how it affects the calculations for various parameters.

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`import math`

In [12]: `data=pd.read_csv(r"C:\Users\Shashank\Downloads\sg_data_01.csv", delimiter=',', skiprows=[0,1]).T`

In [13]: `data`

Out[13]:

	0	1	2	3	4
State	State	Bangladesh	Bangladesh	Bangladesh	Bangladesh
(Head)	(Head)	(ISGS)	(LTA)	(MTOA)	(Bilateral)
Block1	00:00-00:15	185.064431018734	296.619108	245.88831	924.700649018734
Block2	00:15-00:30	185.064431018734	296.619108	245.88831	924.700649018734
Block3	00:30-00:45	184.936528775734	296.619108	245.88831	924.572746775734
...
Block92	22:45-23:00	184.509707543136	296.619108	245.88831	924.145925543136
Block93	23:00-23:15	184.509708529377	296.619108	245.88831	924.145926529377
Block94	23:15-23:30	184.509708529377	296.619108	245.88831	924.145926529377
Block95	23:30-23:45	184.509708529377	296.619108	245.88831	924.145926529377
Block96	23:45-24:00	184.509708529377	296.619108	245.88831	924.145926529377

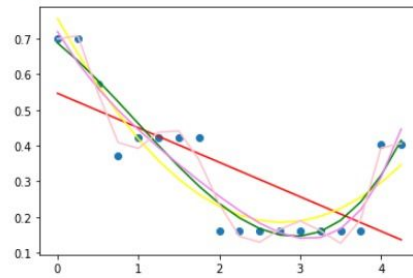
98 rows x 5 columns

In [17]: `plt.xlabel('Time'); plt.ylabel('Scheduled Generation');
plt.scatter(x,y)`

Out[17]: `<matplotlib.collections.PathCollection at 0x1aa53848bc8>`

In [18]: `coef1=np.polyfit(x,y,1)
coef2=np.polyfit(x,y,2)
coef3=np.polyfit(x,y,3)
coef4=np.polyfit(x,y,4)
coef5=np.polyfit(x,y,10)`

```
In [21]: plt.scatter(x,y)
plt.plot(x,np.polyval(coef1,x),color='red')
plt.plot(x,np.polyval(coef2,x),color='yellow')
plt.plot(x,np.polyval(coef3,x),color='green')
plt.plot(x,np.polyval(coef4,x),color='violet')
plt.plot(x,np.polyval(coef5,x),color='pink')
plt.show()
```



```
In [22]: coef5
```

```
Out[22]: array([ 3.95145203e-03, -9.17164654e-02,  8.88392043e-01, -4.65760754e+00,
 1.42959295e+01, -2.58155790e+01,  2.58085948e+01, -1.17745627e+01,
 7.71180675e-01,  2.64221414e-01,  6.99539737e-01])
```