In [2]:
```python
import pandas as pd
import numpy as np

pd.set_option('display.max_rows', 10)
```

Generic

In [3]:
```python
BusTitles = ['Bus ID', 'Bus Type', 'Real Power Demand', 'React Power Demand', 'Shunt Conductance', 'Shunt Susceptance', 'Area', 'Volt Magnitude', 'Volt Angle', 'Base Volt', 'Zone', 'Max Volt Magnitude', 'Min Volt Magnitude']

GeneratorTitles = ['Bus ID', 'Real Power Output', 'React Power Output', 'Max React Power Output','Min React Power Output','Volt Magnitude','mBase','status','Max Real Power Output','Min Real Power Output','Pc1','Pc2','Qc1min','Qc1max','Qc2min','Qc2max','Ramp Rate','10 min Ramp Rate','30 min Ramp Rate','React Power Ramp Rate','APF']

BranchTitles = ['From Bus','To Bus','Resistance','Reactance','Susceptance','RateA','RateB','RateC','Ratio','Angle','Status','Min Angle Difference','Max Angle Difference']

GeneratorCostTitles = ['Model','Startup Cost','Shutdown Cost','Num Coef','Coef1','Coef2','Coef3']
```

Case 14

Bus

In [145]:
```python
Case14Bus = [1,3,0,0,0,0,1,1.06,0,0,1,1.06,0.94,
2,2,21.7,12.7,0,0,1,1.045,-4.98,0,1,1.06,0.94,
3,2,94.2,19,0,0,1,1.01,-12.72,0,1,1.06,0.94,
4,1,47.8,-3.9,0,0,1,1.019,-10.33,0,1,1.06,0.94,
5,1,7.6,1.6,0,0,1,1.02,-8.78,0,1,1.06,0.94,
6,2,11.2,7.5,0,0,1,1.07,-14.22,0,1,1.06,0.94,
7,1,0,0,0,0,1,1.062,-13.37,0,1,1.06,0.94,
8,2,0,0,0,0,1,1.09,-13.36,0,1,1.06,0.94,
9,1,29.5,16.6,0,19,1,1.056,-14.94,0,1,1.06,0.94,
10,1,9,5.8,0,0,1,1.051,-15.1,0,1,1.06,0.94,
11,1,3.5,1.8,0,0,1,1.057,-14.79,0,1,1.06,0.94,
12,1,6.1,1.6,0,0,1,1.055,-15.07,0,1,1.06,0.94,
13,1,13.5,5.8,0,0,1,1.05,-15.16,0,1,1.06,0.94,
14,1,14.9,5,0,0,1,1.036,-16.04,0,1,1.06,0.94]

Case14Generator = [1,232.4,-16.9,10,0,1.06,100,1,332.4,0,0,0,0,0,0,0,0,0,0,
0,0,0,
2,40,42.4,50,-40,1.045,100,1,140,0,0,0,0,0,0,0,0,0,0,0,0,0,
3,0,23.4,40,0,1.01,100,1,100,0,0,0,0,0,0,0,0,0,0,0,0,0,
6,0,12.2,24,-6,1.07,100,1,100,0,0,0,0,0,0,0,0,0,0,0,0,0,
8,0,17.4,24,-6,1.09,100,1,100,0,0,0,0,0,0,0,0,0,0,0,0,0]

Case14Branch = [1,2,0.01938,0.05917,0.0528,0,0,0,0,0,1,-360,360,
1,5,0.05403,0.22304,0.0492,0,0,0,0,0,1,-360,360,
2,3,0.04699,0.19797,0.0438,0,0,0,0,0,1,-360,360,
2,4,0.05811,0.17632,0.034,0,0,0,0,0,1,-360,360,
2,5,0.05695,0.17388,0.0346,0,0,0,0,0,1,-360,360,
3,4,0.06701,0.17103,0.0128,0,0,0,0,0,1,-360,360,
4,5,0.01335,0.04211,0,0,0,0,0,0,1,-360,360,
4,7,0,0.20912,0,0,0,0,0.978,0,1,-360,360,
4,9,0,0.55618,0,0,0,0,0.969,0,1,-360,360,
5,6,0,0.25202,0,0,0,0,0.932,0,1,-360,360,
6,11,0.09498,0.1989,0,0,0,0,0,0,1,-360,360,
6,12,0.12291,0.25581,0,0,0,0,0,0,1,-360,360,
6,13,0.06615,0.13027,0,0,0,0,0,0,1,-360,360,
7,8,0,0.17615,0,0,0,0,0,0,1,-360,360,
7,9,0,0.11001,0,0,0,0,0,0,1,-360,360,
9,10,0.03181,0.0845,0,0,0,0,0,0,1,-360,360,
9,14,0.12711,0.27038,0,0,0,0,0,0,1,-360,360,
10,11,0.08205,0.19207,0,0,0,0,0,0,1,-360,360,
12,13,0.22092,0.19988,0,0,0,0,0,0,1,-360,360,
13,14,0.17093,0.34802,0,0,0,0,0,0,1,-360,360]

Case14GeneratorCost = [2,0,0,3,0.0430292599,20,0,
2,0,0,3,0.25,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0]

Case14BusDF = pd.DataFrame(np.array([Case14Bus[x:x+len(BusTitles)] for x
in range(0, len(Case14Bus), int(len(BusTitles)))]), columns=BusTitles)
display(Case14BusDF)
display(len(Case14Bus)/len(BusTitles))

Case14GeneratorDF = pd.DataFrame(np.array([Case14Generator[x:x+len(Genera
torTitles)] for x in range(0, len(Case14Generator), int(len(GeneratorTitl
es)))]), columns=GeneratorTitles)
```

```python
display(Case14GeneratorDF)
display(len(Case14Generator)/len(GeneratorTitles))

Case14BranchDF = pd.DataFrame(np.array([Case14Branch[x:x+len(BranchTitle
s)] for x in range(0, len(Case14Branch), int(len(BranchTitles)))]), colum
ns=BranchTitles)
display(Case14BranchDF)
display(len(Case14Branch)/len(BranchTitles))

Case14GeneratorCostDF = pd.DataFrame(np.array([Case14GeneratorCost[x:x+le
n(GeneratorCostTitles)] for x in range(0, len(Case14GeneratorCost), int(l
en(GeneratorCostTitles)))]), columns=GeneratorCostTitles)
display(Case14GeneratorCostDF)
display(len(Case14GeneratorCost)/len(GeneratorCostTitles))

Case14BusDF.to_csv('Case 14 Bus.csv', index=False)
Case14GeneratorDF.to_csv('Case 14 Generator.csv', index=False)
Case14BranchDF.to_csv('Case 14 Branch.csv', index=False)
Case14GeneratorCostDF.to_csv('Case 14 Generator Cost.csv', index=False)
```

	Bus ID	Bus Type	Real Power Demand	React Power Demand	Shunt Conductance	Shunt Susceptance	Area	Volt Magnitude	Volt Angle	B V
0	1.0	3.0	0.0	0.0	0.0	0.0	1.0	1.060	0.00	
1	2.0	2.0	21.7	12.7	0.0	0.0	1.0	1.045	-4.98	
2	3.0	2.0	94.2	19.0	0.0	0.0	1.0	1.010	-12.72	
3	4.0	1.0	47.8	-3.9	0.0	0.0	1.0	1.019	-10.33	
4	5.0	1.0	7.6	1.6	0.0	0.0	1.0	1.020	-8.78	
...	...	...	...	...	...	...	...	...	...	
9	10.0	1.0	9.0	5.8	0.0	0.0	1.0	1.051	-15.10	
10	11.0	1.0	3.5	1.8	0.0	0.0	1.0	1.057	-14.79	
11	12.0	1.0	6.1	1.6	0.0	0.0	1.0	1.055	-15.07	
12	13.0	1.0	13.5	5.8	0.0	0.0	1.0	1.050	-15.16	
13	14.0	1.0	14.9	5.0	0.0	0.0	1.0	1.036	-16.04	

14 rows × 13 columns

14.0

	Bus ID	Real Power Output	React Power Output	Max React Power Output	Min React Power Output	Volt Magnitude	mBase	status	Max Real Power Output	Min Real Power Output	...	
0	1.0	232.4	-16.9	10.0	0.0	1.060	100.0	1.0	332.4	0.0	...	
1	2.0	40.0	42.4	50.0	-40.0	1.045	100.0	1.0	140.0	0.0	...	
2	3.0	0.0	23.4	40.0	0.0	1.010	100.0	1.0	100.0	0.0	...	
3	6.0	0.0	12.2	24.0	-6.0	1.070	100.0	1.0	100.0	0.0	...	
4	8.0	0.0	17.4	24.0	-6.0	1.090	100.0	1.0	100.0	0.0	...	

5 rows × 21 columns

5.0

	From Bus	To Bus	Resistance	Reactance	Susceptance	RateA	RateB	RateC	Ratio	Angle
0	1.0	2.0	0.01938	0.05917	0.0528	0.0	0.0	0.0	0.0	0.0
1	1.0	5.0	0.05403	0.22304	0.0492	0.0	0.0	0.0	0.0	0.0
2	2.0	3.0	0.04699	0.19797	0.0438	0.0	0.0	0.0	0.0	0.0
3	2.0	4.0	0.05811	0.17632	0.0340	0.0	0.0	0.0	0.0	0.0
4	2.0	5.0	0.05695	0.17388	0.0346	0.0	0.0	0.0	0.0	0.0
...	...	...	...	...	...	...	...	...	...	...
15	9.0	10.0	0.03181	0.08450	0.0000	0.0	0.0	0.0	0.0	0.0
16	9.0	14.0	0.12711	0.27038	0.0000	0.0	0.0	0.0	0.0	0.0
17	10.0	11.0	0.08205	0.19207	0.0000	0.0	0.0	0.0	0.0	0.0
18	12.0	13.0	0.22092	0.19988	0.0000	0.0	0.0	0.0	0.0	0.0
19	13.0	14.0	0.17093	0.34802	0.0000	0.0	0.0	0.0	0.0	0.0

20 rows × 13 columns

```
20.0
```

	Model	Startup Cost	Shutdown Cost	Num Coef	Coef1	Coef2	Coef3
0	2.0	0.0	0.0	3.0	0.043029	20.0	0.0
1	2.0	0.0	0.0	3.0	0.250000	20.0	0.0
2	2.0	0.0	0.0	3.0	0.010000	40.0	0.0
3	2.0	0.0	0.0	3.0	0.010000	40.0	0.0
4	2.0	0.0	0.0	3.0	0.010000	40.0	0.0

```
5.0
```

Case 57

```
In [5]:  Case57Bus = [1,3,55,17,0,0,1,1.04,0,0,1,1.06,0.94,
         2,2,3,88,0,0,1,1.01,-1.18,0,1,1.06,0.94,
         3,2,41,21,0,0,1,0.985,-5.97,0,1,1.06,0.94,
         4,1,0,0,0,0,1,0.981,-7.32,0,1,1.06,0.94,
         5,1,13,4,0,0,1,0.976,-8.52,0,1,1.06,0.94,
         6,2,75,2,0,0,1,0.98,-8.65,0,1,1.06,0.94,
         7,1,0,0,0,0,1,0.984,-7.58,0,1,1.06,0.94,
         8,2,150,22,0,0,1,1.005,-4.45,0,1,1.06,0.94,
         9,2,121,26,0,0,1,0.98,-9.56,0,1,1.06,0.94,
         10,1,5,2,0,0,1,0.986,-11.43,0,1,1.06,0.94,
         11,1,0,0,0,0,1,0.974,-10.17,0,1,1.06,0.94,
         12,2,377,24,0,0,1,1.015,-10.46,0,1,1.06,0.94,
         13,1,18,2.3,0,0,1,0.979,-9.79,0,1,1.06,0.94,
         14,1,10.5,5.3,0,0,1,0.97,-9.33,0,1,1.06,0.94,
         15,1,22,5,0,0,1,0.988,-7.18,0,1,1.06,0.94,
         16,1,43,3,0,0,1,1.013,-8.85,0,1,1.06,0.94,
         17,1,42,8,0,0,1,1.017,-5.39,0,1,1.06,0.94,
         18,1,27.2,9.8,0,10,1,1.001,-11.71,0,1,1.06,0.94,
         19,1,3.3,0.6,0,0,1,0.97,-13.2,0,1,1.06,0.94,
         20,1,2.3,1,0,0,1,0.964,-13.41,0,1,1.06,0.94,
         21,1,0,0,0,0,1,1.008,-12.89,0,1,1.06,0.94,
         22,1,0,0,0,0,1,1.01,-12.84,0,1,1.06,0.94,
         23,1,6.3,2.1,0,0,1,1.008,-12.91,0,1,1.06,0.94,
         24,1,0,0,0,0,1,0.999,-13.25,0,1,1.06,0.94,
         25,1,6.3,3.2,0,5.9,1,0.982,-18.13,0,1,1.06,0.94,
         26,1,0,0,0,0,1,0.959,-12.95,0,1,1.06,0.94,
         27,1,9.3,0.5,0,0,1,0.982,-11.48,0,1,1.06,0.94,
         28,1,4.6,2.3,0,0,1,0.997,-10.45,0,1,1.06,0.94,
         29,1,17,2.6,0,0,1,1.01,-9.75,0,1,1.06,0.94,
         30,1,3.6,1.8,0,0,1,0.962,-18.68,0,1,1.06,0.94,
         31,1,5.8,2.9,0,0,1,0.936,-19.34,0,1,1.06,0.94,
         32,1,1.6,0.8,0,0,1,0.949,-18.46,0,1,1.06,0.94,
         33,1,3.8,1.9,0,0,1,0.947,-18.5,0,1,1.06,0.94,
         34,1,0,0,0,0,1,0.959,-14.1,0,1,1.06,0.94,
         35,1,6,3,0,0,1,0.966,-13.86,0,1,1.06,0.94,
         36,1,0,0,0,0,1,0.976,-13.59,0,1,1.06,0.94,
         37,1,0,0,0,0,1,0.985,-13.41,0,1,1.06,0.94,
         38,1,14,7,0,0,1,1.013,-12.71,0,1,1.06,0.94,
         39,1,0,0,0,0,1,0.983,-13.46,0,1,1.06,0.94,
         40,1,0,0,0,0,1,0.973,-13.62,0,1,1.06,0.94,
         41,1,6.3,3,0,0,1,0.996,-14.05,0,1,1.06,0.94,
         42,1,7.1,4.4,0,0,1,0.966,-15.5,0,1,1.06,0.94,
         43,1,2,1,0,0,1,1.01,-11.33,0,1,1.06,0.94,
         44,1,12,1.8,0,0,1,1.017,-11.86,0,1,1.06,0.94,
         45,1,0,0,0,0,1,1.036,-9.25,0,1,1.06,0.94,
         46,1,0,0,0,0,1,1.05,-11.89,0,1,1.06,0.94,
         47,1,29.7,11.6,0,0,1,1.033,-12.49,0,1,1.06,0.94,
         48,1,0,0,0,0,1,1.027,-12.59,0,1,1.06,0.94,
         49,1,18,8.5,0,0,1,1.036,-12.92,0,1,1.06,0.94,
         50,1,21,10.5,0,0,1,1.023,-13.39,0,1,1.06,0.94,
         51,1,18,5.3,0,0,1,1.052,-12.52,0,1,1.06,0.94,
         52,1,4.9,2.2,0,0,1,0.98,-11.47,0,1,1.06,0.94,
         53,1,20,10,0,6.3,1,0.971,-12.23,0,1,1.06,0.94,
         54,1,4.1,1.4,0,0,1,0.996,-11.69,0,1,1.06,0.94,
         55,1,6.8,3.4,0,0,1,1.031,-10.78,0,1,1.06,0.94,
         56,1,7.6,2.2,0,0,1,0.968,-16.04,0,1,1.06,0.94,
         57,1,6.7,2,0,0,1,0.965,-16.56,0,1,1.06,0.94]
```

```
Case57Generator = [1,128.9,-16.1,200,-140,1.04,100,1,575.88,0,0,0,0,0,0,
0,0,0,0,0,0,
2,0,-0.8,50,-17,1.01,100,1,100,0,0,0,0,0,0,0,0,0,0,0,0,
3,40,-1,60,-10,0.985,100,1,140,0,0,0,0,0,0,0,0,0,0,0,0,
6,0,0.8,25,-8,0.98,100,1,100,0,0,0,0,0,0,0,0,0,0,0,0,
8,450,62.1,200,-140,1.005,100,1,550,0,0,0,0,0,0,0,0,0,0,0,0,
9,0,2.2,9,-3,0.98,100,1,100,0,0,0,0,0,0,0,0,0,0,0,0,
12,310,128.5,155,-150,1.015,100,1,410,0,0,0,0,0,0,0,0,0,0,0,0]


Case57Branch = [1,2,0.0083,0.028,0.129,0,0,0,0,0,1,-360,360,
2,3,0.0298,0.085,0.0818,0,0,0,0,0,1,-360,360,
3,4,0.0112,0.0366,0.038,0,0,0,0,0,1,-360,360,
4,5,0.0625,0.132,0.0258,0,0,0,0,0,1,-360,360,
4,6,0.043,0.148,0.0348,0,0,0,0,0,1,-360,360,
6,7,0.02,0.102,0.0276,0,0,0,0,0,1,-360,360,
6,8,0.0339,0.173,0.047,0,0,0,0,0,1,-360,360,
8,9,0.0099,0.0505,0.0548,0,0,0,0,0,1,-360,360,
9,10,0.0369,0.1679,0.044,0,0,0,0,0,1,-360,360,
9,11,0.0258,0.0848,0.0218,0,0,0,0,0,1,-360,360,
9,12,0.0648,0.295,0.0772,0,0,0,0,0,1,-360,360,
9,13,0.0481,0.158,0.0406,0,0,0,0,0,1,-360,360,
13,14,0.0132,0.0434,0.011,0,0,0,0,0,1,-360,360,
13,15,0.0269,0.0869,0.023,0,0,0,0,0,1,-360,360,
1,15,0.0178,0.091,0.0988,0,0,0,0,0,1,-360,360,
1,16,0.0454,0.206,0.0546,0,0,0,0,0,1,-360,360,
1,17,0.0238,0.108,0.0286,0,0,0,0,0,1,-360,360,
3,15,0.0162,0.053,0.0544,0,0,0,0,0,1,-360,360,
4,18,0,0.555,0,0,0,0,0.97,0,1,-360,360,
4,18,0,0.43,0,0,0,0,0.978,0,1,-360,360,
5,6,0.0302,0.0641,0.0124,0,0,0,0,0,1,-360,360,
7,8,0.0139,0.0712,0.0194,0,0,0,0,0,1,-360,360,
10,12,0.0277,0.1262,0.0328,0,0,0,0,0,1,-360,360,
11,13,0.0223,0.0732,0.0188,0,0,0,0,0,1,-360,360,
12,13,0.0178,0.058,0.0604,0,0,0,0,0,1,-360,360,
12,16,0.018,0.0813,0.0216,0,0,0,0,0,1,-360,360,
12,17,0.0397,0.179,0.0476,0,0,0,0,0,1,-360,360,
14,15,0.0171,0.0547,0.0148,0,0,0,0,0,1,-360,360,
18,19,0.461,0.685,0,0,0,0,0,0,1,-360,360,
19,20,0.283,0.434,0,0,0,0,0,0,1,-360,360,
21,20,0,0.7767,0,0,0,0,1.043,0,1,-360,360,
21,22,0.0736,0.117,0,0,0,0,0,0,1,-360,360,
22,23,0.0099,0.0152,0,0,0,0,0,0,1,-360,360,
23,24,0.166,0.256,0.0084,0,0,0,0,0,1,-360,360,
24,25,0,1.182,0,0,0,0,1,0,1,-360,360,
24,25,0,1.23,0,0,0,0,1,0,1,-360,360,
24,26,0,0.0473,0,0,0,0,1.043,0,1,-360,360,
26,27,0.165,0.254,0,0,0,0,0,0,1,-360,360,
27,28,0.0618,0.0954,0,0,0,0,0,0,1,-360,360,
28,29,0.0418,0.0587,0,0,0,0,0,0,1,-360,360,
7,29,0,0.0648,0,0,0,0,0.967,0,1,-360,360,
25,30,0.135,0.202,0,0,0,0,0,0,1,-360,360,
30,31,0.326,0.497,0,0,0,0,0,0,1,-360,360,
31,32,0.507,0.755,0,0,0,0,0,0,1,-360,360,
32,33,0.0392,0.036,0,0,0,0,0,0,1,-360,360,
34,32,0,0.953,0,0,0,0,0.975,0,1,-360,360,
34,35,0.052,0.078,0.0032,0,0,0,0,0,1,-360,360,
35,36,0.043,0.0537,0.0016,0,0,0,0,0,1,-360,360,
36,37,0.029,0.0366,0,0,0,0,0,0,1,-360,360,
```

```
37,38,0.0651,0.1009,0.002,0,0,0,0,0,1,-360,360,
37,39,0.0239,0.0379,0,0,0,0,0,0,1,-360,360,
36,40,0.03,0.0466,0,0,0,0,0,0,1,-360,360,
22,38,0.0192,0.0295,0,0,0,0,0,0,1,-360,360,
11,41,0,0.749,0,0,0,0,0.955,0,1,-360,360,
41,42,0.207,0.352,0,0,0,0,0,0,1,-360,360,
41,43,0,0.412,0,0,0,0,0,0,1,-360,360,
38,44,0.0289,0.0585,0.002,0,0,0,0,0,1,-360,360,
15,45,0,0.1042,0,0,0,0,0.955,0,1,-360,360,
14,46,0,0.0735,0,0,0,0,0.9,0,1,-360,360,
46,47,0.023,0.068,0.0032,0,0,0,0,0,1,-360,360,
47,48,0.0182,0.0233,0,0,0,0,0,0,1,-360,360,
48,49,0.0834,0.129,0.0048,0,0,0,0,0,1,-360,360,
49,50,0.0801,0.128,0,0,0,0,0,0,1,-360,360,
50,51,0.1386,0.22,0,0,0,0,0,0,1,-360,360,
10,51,0,0.0712,0,0,0,0,0.93,0,1,-360,360,
13,49,0,0.191,0,0,0,0,0.895,0,1,-360,360,
29,52,0.1442,0.187,0,0,0,0,0,0,1,-360,360,
52,53,0.0762,0.0984,0,0,0,0,0,0,1,-360,360,
53,54,0.1878,0.232,0,0,0,0,0,0,1,-360,360,
54,55,0.1732,0.2265,0,0,0,0,0,0,1,-360,360,
11,43,0,0.153,0,0,0,0,0.958,0,1,-360,360,
44,45,0.0624,0.1242,0.004,0,0,0,0,0,1,-360,360,
40,56,0,1.195,0,0,0,0,0.958,0,1,-360,360,
56,41,0.553,0.549,0,0,0,0,0,0,1,-360,360,
56,42,0.2125,0.354,0,0,0,0,0,0,1,-360,360,
39,57,0,1.355,0,0,0,0,0.98,0,1,-360,360,
57,56,0.174,0.26,0,0,0,0,0,0,1,-360,360,
38,49,0.115,0.177,0.003,0,0,0,0,0,1,-360,360,
38,48,0.0312,0.0482,0,0,0,0,0,0,1,-360,360,
9,55,0,0.1205,0,0,0,0,0.94,0,1,-360,360]


Case57GeneratorCost = [2,0,0,3,0.077579519,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.25,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.0222222222,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.0322580645,20,0]


Case57BusDF = pd.DataFrame(np.array([Case57Bus[x:x+len(BusTitles)] for x
in range(0, len(Case57Bus), int(len(BusTitles)))]), columns=BusTitles)
display(Case57BusDF)
display(len(Case57Bus)/len(BusTitles))

Case57GeneratorDF = pd.DataFrame(np.array([Case57Generator[x:x+len(Genera
torTitles)] for x in range(0, len(Case57Generator), int(len(GeneratorTitl
es)))]), columns=GeneratorTitles)
display(Case57GeneratorDF)
display(len(Case57Generator)/len(GeneratorTitles))

Case57BranchDF = pd.DataFrame(np.array([Case57Branch[x:x+len(BranchTitle
s)] for x in range(0, len(Case57Branch), int(len(BranchTitles)))]), colum
ns=BranchTitles)
display(Case57BranchDF)
display(len(Case57Branch)/len(BranchTitles))

Case57GeneratorCostDF = pd.DataFrame(np.array([Case57GeneratorCost[x:x+le
```

```python
n(GeneratorCostTitles)] for x in range(0, len(Case57GeneratorCost), int(l
en(GeneratorCostTitles)))]), columns=GeneratorCostTitles)
display(Case57GeneratorCostDF)
display(len(Case57GeneratorCost)/len(GeneratorCostTitles))

Case57BusDF.to_csv('Case 57 Bus.csv', index=False)
Case57GeneratorDF.to_csv('Case 57 Generator.csv', index=False)
Case57BranchDF.to_csv('Case 57 Branch.csv', index=False)
Case57GeneratorCostDF.to_csv('Case 57 Generator Cost.csv', index=False)
```

	Bus ID	Bus Type	Real Power Demand	React Power Demand	Shunt Conductance	Shunt Susceptance	Area	Volt Magnitude	Volt Angle	B V
0	1.0	3.0	55.0	17.0	0.0	0.0	1.0	1.040	0.00	
1	2.0	2.0	3.0	88.0	0.0	0.0	1.0	1.010	-1.18	
2	3.0	2.0	41.0	21.0	0.0	0.0	1.0	0.985	-5.97	
3	4.0	1.0	0.0	0.0	0.0	0.0	1.0	0.981	-7.32	
4	5.0	1.0	13.0	4.0	0.0	0.0	1.0	0.976	-8.52	
...	...	...	...	...	...	...	...	...	...	
52	53.0	1.0	20.0	10.0	0.0	6.3	1.0	0.971	-12.23	
53	54.0	1.0	4.1	1.4	0.0	0.0	1.0	0.996	-11.69	
54	55.0	1.0	6.8	3.4	0.0	0.0	1.0	1.031	-10.78	
55	56.0	1.0	7.6	2.2	0.0	0.0	1.0	0.968	-16.04	
56	57.0	1.0	6.7	2.0	0.0	0.0	1.0	0.965	-16.56	

57 rows × 13 columns

57.0

	Bus ID	Real Power Output	React Power Output	Max React Power Output	Min React Power Output	Volt Magnitude	mBase	status	Max Real Power Output	Min Real Power Output	...	
0	1.0	128.9	-16.1	200.0	-140.0	1.040	100.0	1.0	575.88	0.0	...	
1	2.0	0.0	-0.8	50.0	-17.0	1.010	100.0	1.0	100.00	0.0	...	
2	3.0	40.0	-1.0	60.0	-10.0	0.985	100.0	1.0	140.00	0.0	...	
3	6.0	0.0	0.8	25.0	-8.0	0.980	100.0	1.0	100.00	0.0	...	
4	8.0	450.0	62.1	200.0	-140.0	1.005	100.0	1.0	550.00	0.0	...	
5	9.0	0.0	2.2	9.0	-3.0	0.980	100.0	1.0	100.00	0.0	...	
6	12.0	310.0	128.5	155.0	-150.0	1.015	100.0	1.0	410.00	0.0	...	

7 rows × 21 columns

7.0

	From Bus	To Bus	Resistance	Reactance	Susceptance	RateA	RateB	RateC	Ratio	Angle
0	1.0	2.0	0.0083	0.0280	0.1290	0.0	0.0	0.0	0.00	0.0
1	2.0	3.0	0.0298	0.0850	0.0818	0.0	0.0	0.0	0.00	0.0
2	3.0	4.0	0.0112	0.0366	0.0380	0.0	0.0	0.0	0.00	0.0
3	4.0	5.0	0.0625	0.1320	0.0258	0.0	0.0	0.0	0.00	0.0
4	4.0	6.0	0.0430	0.1480	0.0348	0.0	0.0	0.0	0.00	0.0
...	...	...	...	...	...	...	...	...	...	...
75	39.0	57.0	0.0000	1.3550	0.0000	0.0	0.0	0.0	0.98	0.0
76	57.0	56.0	0.1740	0.2600	0.0000	0.0	0.0	0.0	0.00	0.0
77	38.0	49.0	0.1150	0.1770	0.0030	0.0	0.0	0.0	0.00	0.0
78	38.0	48.0	0.0312	0.0482	0.0000	0.0	0.0	0.0	0.00	0.0
79	9.0	55.0	0.0000	0.1205	0.0000	0.0	0.0	0.0	0.94	0.0

80 rows × 13 columns

```
80.0
```

	Model	Startup Cost	Shutdown Cost	Num Coef	Coef1	Coef2	Coef3
0	2.0	0.0	0.0	3.0	0.077580	20.0	0.0
1	2.0	0.0	0.0	3.0	0.010000	40.0	0.0
2	2.0	0.0	0.0	3.0	0.250000	20.0	0.0
3	2.0	0.0	0.0	3.0	0.010000	40.0	0.0
4	2.0	0.0	0.0	3.0	0.022222	20.0	0.0
5	2.0	0.0	0.0	3.0	0.010000	40.0	0.0
6	2.0	0.0	0.0	3.0	0.032258	20.0	0.0

```
7.0
```

Case 118

In [6]:
```
Case118Bus = [1,2,51,27,0,0,1,0.955,10.67,138,1,1.06,0.94,
2,1,20,9,0,0,1,0.971,11.22,138,1,1.06,0.94,
3,1,39,10,0,0,1,0.968,11.56,138,1,1.06,0.94,
4,2,39,12,0,0,1,0.998,15.28,138,1,1.06,0.94,
5,1,0,0,0,-40,1,1.002,15.73,138,1,1.06,0.94,
6,2,52,22,0,0,1,0.99,13,138,1,1.06,0.94,
7,1,19,2,0,0,1,0.989,12.56,138,1,1.06,0.94,
8,2,28,0,0,0,1,1.015,20.77,345,1,1.06,0.94,
9,1,0,0,0,0,1,1.043,28.02,345,1,1.06,0.94,
10,2,0,0,0,0,1,1.05,35.61,345,1,1.06,0.94,
11,1,70,23,0,0,1,0.985,12.72,138,1,1.06,0.94,
12,2,47,10,0,0,1,0.99,12.2,138,1,1.06,0.94,
13,1,34,16,0,0,1,0.968,11.35,138,1,1.06,0.94,
14,1,14,1,0,0,1,0.984,11.5,138,1,1.06,0.94,
15,2,90,30,0,0,1,0.97,11.23,138,1,1.06,0.94,
16,1,25,10,0,0,1,0.984,11.91,138,1,1.06,0.94,
17,1,11,3,0,0,1,0.995,13.74,138,1,1.06,0.94,
18,2,60,34,0,0,1,0.973,11.53,138,1,1.06,0.94,
19,2,45,25,0,0,1,0.963,11.05,138,1,1.06,0.94,
20,1,18,3,0,0,1,0.958,11.93,138,1,1.06,0.94,
21,1,14,8,0,0,1,0.959,13.52,138,1,1.06,0.94,
22,1,10,5,0,0,1,0.97,16.08,138,1,1.06,0.94,
23,1,7,3,0,0,1,1,21,138,1,1.06,0.94,
24,2,13,0,0,0,1,0.992,20.89,138,1,1.06,0.94,
25,2,0,0,0,0,1,1.05,27.93,138,1,1.06,0.94,
26,2,0,0,0,0,1,1.015,29.71,345,1,1.06,0.94,
27,2,71,13,0,0,1,0.968,15.35,138,1,1.06,0.94,
28,1,17,7,0,0,1,0.962,13.62,138,1,1.06,0.94,
29,1,24,4,0,0,1,0.963,12.63,138,1,1.06,0.94,
30,1,0,0,0,0,1,0.968,18.79,345,1,1.06,0.94,
31,2,43,27,0,0,1,0.967,12.75,138,1,1.06,0.94,
32,2,59,23,0,0,1,0.964,14.8,138,1,1.06,0.94,
33,1,23,9,0,0,1,0.972,10.63,138,1,1.06,0.94,
34,2,59,26,0,14,1,0.986,11.3,138,1,1.06,0.94,
35,1,33,9,0,0,1,0.981,10.87,138,1,1.06,0.94,
36,2,31,17,0,0,1,0.98,10.87,138,1,1.06,0.94,
37,1,0,0,0,-25,1,0.992,11.77,138,1,1.06,0.94,
38,1,0,0,0,0,1,0.962,16.91,345,1,1.06,0.94,
39,1,27,11,0,0,1,0.97,8.41,138,1,1.06,0.94,
40,2,66,23,0,0,1,0.97,7.35,138,1,1.06,0.94,
41,1,37,10,0,0,1,0.967,6.92,138,1,1.06,0.94,
42,2,96,23,0,0,1,0.985,8.53,138,1,1.06,0.94,
43,1,18,7,0,0,1,0.978,11.28,138,1,1.06,0.94,
44,1,16,8,0,10,1,0.985,13.82,138,1,1.06,0.94,
45,1,53,22,0,10,1,0.987,15.67,138,1,1.06,0.94,
46,2,28,10,0,10,1,1.005,18.49,138,1,1.06,0.94,
47,1,34,0,0,0,1,1.017,20.73,138,1,1.06,0.94,
48,1,20,11,0,15,1,1.021,19.93,138,1,1.06,0.94,
49,2,87,30,0,0,1,1.025,20.94,138,1,1.06,0.94,
50,1,17,4,0,0,1,1.001,18.9,138,1,1.06,0.94,
51,1,17,8,0,0,1,0.967,16.28,138,1,1.06,0.94,
52,1,18,5,0,0,1,0.957,15.32,138,1,1.06,0.94,
53,1,23,11,0,0,1,0.946,14.35,138,1,1.06,0.94,
54,2,113,32,0,0,1,0.955,15.26,138,1,1.06,0.94,
55,2,63,22,0,0,1,0.952,14.97,138,1,1.06,0.94,
56,2,84,18,0,0,1,0.954,15.16,138,1,1.06,0.94,
57,1,12,3,0,0,1,0.971,16.36,138,1,1.06,0.94,
```

```
58,1,12,3,0,0,1,0.959,15.51,138,1,1.06,0.94,
59,2,277,113,0,0,1,0.985,19.37,138,1,1.06,0.94,
60,1,78,3,0,0,1,0.993,23.15,138,1,1.06,0.94,
61,2,0,0,0,0,1,0.995,24.04,138,1,1.06,0.94,
62,2,77,14,0,0,1,0.998,23.43,138,1,1.06,0.94,
63,1,0,0,0,0,1,0.969,22.75,345,1,1.06,0.94,
64,1,0,0,0,0,1,0.984,24.52,345,1,1.06,0.94,
65,2,0,0,0,0,1,1.005,27.65,345,1,1.06,0.94,
66,2,39,18,0,0,1,1.05,27.48,138,1,1.06,0.94,
67,1,28,7,0,0,1,1.02,24.84,138,1,1.06,0.94,
68,1,0,0,0,0,1,1.003,27.55,345,1,1.06,0.94,
69,3,0,0,0,0,1,1.035,30,138,1,1.06,0.94,
70,2,66,20,0,0,1,0.984,22.58,138,1,1.06,0.94,
71,1,0,0,0,0,1,0.987,22.15,138,1,1.06,0.94,
72,2,12,0,0,0,1,0.98,20.98,138,1,1.06,0.94,
73,2,6,0,0,0,1,0.991,21.94,138,1,1.06,0.94,
74,2,68,27,0,12,1,0.958,21.64,138,1,1.06,0.94,
75,1,47,11,0,0,1,0.967,22.91,138,1,1.06,0.94,
76,2,68,36,0,0,1,0.943,21.77,138,1,1.06,0.94,
77,2,61,28,0,0,1,1.006,26.72,138,1,1.06,0.94,
78,1,71,26,0,0,1,1.003,26.42,138,1,1.06,0.94,
79,1,39,32,0,20,1,1.009,26.72,138,1,1.06,0.94,
80,2,130,26,0,0,1,1.04,28.96,138,1,1.06,0.94,
81,1,0,0,0,0,1,0.997,28.1,345,1,1.06,0.94,
82,1,54,27,0,20,1,0.989,27.24,138,1,1.06,0.94,
83,1,20,10,0,10,1,0.985,28.42,138,1,1.06,0.94,
84,1,11,7,0,0,1,0.98,30.95,138,1,1.06,0.94,
85,2,24,15,0,0,1,0.985,32.51,138,1,1.06,0.94,
86,1,21,10,0,0,1,0.987,31.14,138,1,1.06,0.94,
87,2,0,0,0,0,1,1.015,31.4,161,1,1.06,0.94,
88,1,48,10,0,0,1,0.987,35.64,138,1,1.06,0.94,
89,2,0,0,0,0,1,1.005,39.69,138,1,1.06,0.94,
90,2,163,42,0,0,1,0.985,33.29,138,1,1.06,0.94,
91,2,10,0,0,0,1,0.98,33.31,138,1,1.06,0.94,
92,2,65,10,0,0,1,0.993,33.8,138,1,1.06,0.94,
93,1,12,7,0,0,1,0.987,30.79,138,1,1.06,0.94,
94,1,30,16,0,0,1,0.991,28.64,138,1,1.06,0.94,
95,1,42,31,0,0,1,0.981,27.67,138,1,1.06,0.94,
96,1,38,15,0,0,1,0.993,27.51,138,1,1.06,0.94,
97,1,15,9,0,0,1,1.011,27.88,138,1,1.06,0.94,
98,1,34,8,0,0,1,1.024,27.4,138,1,1.06,0.94,
99,2,42,0,0,0,1,1.01,27.04,138,1,1.06,0.94,
100,2,37,18,0,0,1,1.017,28.03,138,1,1.06,0.94,
101,1,22,15,0,0,1,0.993,29.61,138,1,1.06,0.94,
102,1,5,3,0,0,1,0.991,32.3,138,1,1.06,0.94,
103,2,23,16,0,0,1,1.001,24.44,138,1,1.06,0.94,
104,2,38,25,0,0,1,0.971,21.69,138,1,1.06,0.94,
105,2,31,26,0,20,1,0.965,20.57,138,1,1.06,0.94,
106,1,43,16,0,0,1,0.962,20.32,138,1,1.06,0.94,
107,2,50,12,0,6,1,0.952,17.53,138,1,1.06,0.94,
108,1,2,1,0,0,1,0.967,19.38,138,1,1.06,0.94,
109,1,8,3,0,0,1,0.967,18.93,138,1,1.06,0.94,
110,2,39,30,0,6,1,0.973,18.09,138,1,1.06,0.94,
111,2,0,0,0,0,1,0.98,19.74,138,1,1.06,0.94,
112,2,68,13,0,0,1,0.975,14.99,138,1,1.06,0.94,
113,2,6,0,0,0,1,0.993,13.74,138,1,1.06,0.94,
114,1,8,3,0,0,1,0.96,14.46,138,1,1.06,0.94,
115,1,22,7,0,0,1,0.96,14.46,138,1,1.06,0.94,
```

```
116,2,184,0,0,0,1,1.005,27.12,138,1,1.06,0.94,
117,1,20,8,0,0,1,0.974,10.67,138,1,1.06,0.94,
118,1,33,15,0,0,1,0.949,21.92,138,1,1.06,0.94]

Case118Generator = [1,0,0,15,-5,0.955,100,1,100,0,0,0,0,0,0,0,0,0,0,0,0,
4,0,0,300,-300,0.998,100,1,100,0,0,0,0,0,0,0,0,0,0,0,0,
6,0,0,50,-13,0.99,100,1,100,0,0,0,0,0,0,0,0,0,0,0,0,
8,0,0,300,-300,1.015,100,1,100,0,0,0,0,0,0,0,0,0,0,0,0,
10,450,0,200,-147,1.05,100,1,550,0,0,0,0,0,0,0,0,0,0,0,0,
12,85,0,120,-35,0.99,100,1,185,0,0,0,0,0,0,0,0,0,0,0,0,
15,0,0,30,-10,0.97,100,1,100,0,0,0,0,0,0,0,0,0,0,0,0,
18,0,0,50,-16,0.973,100,1,100,0,0,0,0,0,0,0,0,0,0,0,0,
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100,103,0.016,0.0525,0.0536,0,0,0,0,0,1,-360,360,
100,104,0.0451,0.204,0.0541,0,0,0,0,0,1,-360,360,
103,104,0.0466,0.1584,0.0407,0,0,0,0,0,1,-360,360,
103,105,0.0535,0.1625,0.0408,0,0,0,0,0,1,-360,360,
100,106,0.0605,0.229,0.062,0,0,0,0,0,1,-360,360,
104,105,0.00994,0.0378,0.00986,0,0,0,0,0,1,-360,360,
105,106,0.014,0.0547,0.01434,0,0,0,0,0,1,-360,360,
105,107,0.053,0.183,0.0472,0,0,0,0,0,1,-360,360,
105,108,0.0261,0.0703,0.01844,0,0,0,0,0,1,-360,360,
106,107,0.053,0.183,0.0472,0,0,0,0,0,1,-360,360,
108,109,0.0105,0.0288,0.0076,0,0,0,0,0,1,-360,360,
```

```
103,110,0.03906,0.1813,0.0461,0,0,0,0,0,1,-360,360,
109,110,0.0278,0.0762,0.0202,0,0,0,0,0,1,-360,360,
110,111,0.022,0.0755,0.02,0,0,0,0,0,1,-360,360,
110,112,0.0247,0.064,0.062,0,0,0,0,0,1,-360,360,
17,113,0.00913,0.0301,0.00768,0,0,0,0,0,1,-360,360,
32,113,0.0615,0.203,0.0518,0,0,0,0,0,1,-360,360,
32,114,0.0135,0.0612,0.01628,0,0,0,0,0,1,-360,360,
27,115,0.0164,0.0741,0.01972,0,0,0,0,0,1,-360,360,
114,115,0.0023,0.0104,0.00276,0,0,0,0,0,1,-360,360,
68,116,0.00034,0.00405,0.164,0,0,0,0,0,1,-360,360,
12,117,0.0329,0.14,0.0358,0,0,0,0,0,1,-360,360,
75,118,0.0145,0.0481,0.01198,0,0,0,0,0,1,-360,360,
76,118,0.0164,0.0544,0.01356,0,0,0,0,0,1,-360,360]


Case118GeneratorCost = [2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.0222222222,20,0,
2,0,0,3,0.117647059,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.0454545455,20,0,
2,0,0,3,0.0318471338,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,1.42857143,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.526315789,20,0,
2,0,0,3,0.0490196078,20,0,
2,0,0,3,0.208333333,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.064516129,20,0,
2,0,0,3,0.0625,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.0255754476,20,0,
2,0,0,3,0.0255102041,20,0,
2,0,0,3,0.0193648335,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.0209643606,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,2.5,20,0,
2,0,0,3,0.0164744646,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
```

```
2,0,0,3,0.0396825397,20,0,
2,0,0,3,0.25,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.277777778,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0]

Case118BusDF = pd.DataFrame(np.array([Case118Bus[x:x+len(BusTitles)] for
x in range(0, len(Case118Bus), int(len(BusTitles)))]), columns=BusTitles)
display(Case118BusDF)
display(len(Case118Bus)/len(BusTitles))

Case118GeneratorDF = pd.DataFrame(np.array([Case118Generator[x:x+len(Gene
ratorTitles)] for x in range(0, len(Case118Generator), int(len(GeneratorT
itles)))]), columns=GeneratorTitles)
display(Case118GeneratorDF)
display(len(Case118Generator)/len(GeneratorTitles))

Case118BranchDF = pd.DataFrame(np.array([Case118Branch[x:x+len(BranchTitl
es)] for x in range(0, len(Case118Branch), int(len(BranchTitles)))]), col
umns=BranchTitles)
display(Case118BranchDF)
display(len(Case118Branch)/len(BranchTitles))

Case118GeneratorCostDF = pd.DataFrame(np.array([Case118GeneratorCost[x:x
+len(GeneratorCostTitles)] for x in range(0, len(Case118GeneratorCost), i
nt(len(GeneratorCostTitles)))]), columns=GeneratorCostTitles)
display(Case118GeneratorCostDF)
display(len(Case118GeneratorCost)/len(GeneratorCostTitles))

Case118BusDF.to_csv('Case 118 Bus.csv', index=False)
Case118GeneratorDF.to_csv('Case 118 Generator.csv', index=False)
Case118BranchDF.to_csv('Case 118 Branch.csv', index=False)
Case118GeneratorCostDF.to_csv('Case 118 Generator Cost.csv', index=False)
```

	Bus ID	Bus Type	Real Power Demand	React Power Demand	Shunt Conductance	Shunt Susceptance	Area	Volt Magnitude	Volt Angle
0	1.0	2.0	51.0	27.0	0.0	0.0	1.0	0.955	10.67
1	2.0	1.0	20.0	9.0	0.0	0.0	1.0	0.971	11.22
2	3.0	1.0	39.0	10.0	0.0	0.0	1.0	0.968	11.56
3	4.0	2.0	39.0	12.0	0.0	0.0	1.0	0.998	15.28
4	5.0	1.0	0.0	0.0	0.0	-40.0	1.0	1.002	15.73
...	...	...	...	...	...	...	...	...	...
113	114.0	1.0	8.0	3.0	0.0	0.0	1.0	0.960	14.46
114	115.0	1.0	22.0	7.0	0.0	0.0	1.0	0.960	14.46
115	116.0	2.0	184.0	0.0	0.0	0.0	1.0	1.005	27.12
116	117.0	1.0	20.0	8.0	0.0	0.0	1.0	0.974	10.67
117	118.0	1.0	33.0	15.0	0.0	0.0	1.0	0.949	21.92

118 rows × 13 columns

118.0

	Bus ID	Real Power Output	React Power Output	Max React Power Output	Min React Power Output	Volt Magnitude	mBase	status	Max Real Power Output	Min Real Power Output	...
0	1.0	0.0	0.0	15.0	-5.0	0.955	100.0	1.0	100.0	0.0	...
1	4.0	0.0	0.0	300.0	-300.0	0.998	100.0	1.0	100.0	0.0	...
2	6.0	0.0	0.0	50.0	-13.0	0.990	100.0	1.0	100.0	0.0	...
3	8.0	0.0	0.0	300.0	-300.0	1.015	100.0	1.0	100.0	0.0	...
4	10.0	450.0	0.0	200.0	-147.0	1.050	100.0	1.0	550.0	0.0	...
...	...	...	...	...	...	...	...	...	...	...	...
49	110.0	0.0	0.0	23.0	-8.0	0.973	100.0	1.0	100.0	0.0	...
50	111.0	36.0	0.0	1000.0	-100.0	0.980	100.0	1.0	136.0	0.0	...
51	112.0	0.0	0.0	1000.0	-100.0	0.975	100.0	1.0	100.0	0.0	...
52	113.0	0.0	0.0	200.0	-100.0	0.993	100.0	1.0	100.0	0.0	...
53	116.0	0.0	0.0	1000.0	-1000.0	1.005	100.0	1.0	100.0	0.0	...

54 rows × 21 columns

54.0

	From Bus	To Bus	Resistance	Reactance	Susceptance	RateA	RateB	RateC	Ratio	Angl
0	1.0	2.0	0.03030	0.09990	0.02540	0.0	0.0	0.0	0.0	0.0
1	1.0	3.0	0.01290	0.04240	0.01082	0.0	0.0	0.0	0.0	0.0
2	4.0	5.0	0.00176	0.00798	0.00210	0.0	0.0	0.0	0.0	0.0
3	3.0	5.0	0.02410	0.10800	0.02840	0.0	0.0	0.0	0.0	0.0
4	5.0	6.0	0.01190	0.05400	0.01426	0.0	0.0	0.0	0.0	0.0
...	...	...	...	...	...	...	...	...	...	.
181	114.0	115.0	0.00230	0.01040	0.00276	0.0	0.0	0.0	0.0	0.0
182	68.0	116.0	0.00034	0.00405	0.16400	0.0	0.0	0.0	0.0	0.0
183	12.0	117.0	0.03290	0.14000	0.03580	0.0	0.0	0.0	0.0	0.0
184	75.0	118.0	0.01450	0.04810	0.01198	0.0	0.0	0.0	0.0	0.0
185	76.0	118.0	0.01640	0.05440	0.01356	0.0	0.0	0.0	0.0	0.0

186 rows × 13 columns

186.0

	Model	Startup Cost	Shutdown Cost	Num Coef	Coef1	Coef2	Coef3
0	2.0	0.0	0.0	3.0	0.010000	40.0	0.0
1	2.0	0.0	0.0	3.0	0.010000	40.0	0.0
2	2.0	0.0	0.0	3.0	0.010000	40.0	0.0
3	2.0	0.0	0.0	3.0	0.010000	40.0	0.0
4	2.0	0.0	0.0	3.0	0.022222	20.0	0.0
...	...	...	...	...	...	...	...
49	2.0	0.0	0.0	3.0	0.010000	40.0	0.0
50	2.0	0.0	0.0	3.0	0.277778	20.0	0.0
51	2.0	0.0	0.0	3.0	0.010000	40.0	0.0
52	2.0	0.0	0.0	3.0	0.010000	40.0	0.0
53	2.0	0.0	0.0	3.0	0.010000	40.0	0.0

54 rows × 7 columns

54.0

Case 300

```
In [7]: Case300Bus = [1,1,90,49,0,0,1,1.0284,5.95,115,1,1.06,0.94,
        2,1,56,15,0,0,1,1.0354,7.74,115,1,1.06,0.94,
        3,1,20,0,0,0,1,0.9971,6.64,230,1,1.06,0.94,
        4,1,0,0,0,0,1,1.0308,4.71,345,1,1.06,0.94,
        5,1,353,130,0,0,1,1.0191,4.68,115,1,1.06,0.94,
        6,1,120,41,0,0,1,1.0312,6.99,115,1,1.06,0.94,
        7,1,0,0,0,0,1,0.9934,6.19,230,1,1.06,0.94,
        8,2,63,14,0,0,1,1.0153,2.4,115,1,1.06,0.94,
        9,1,96,43,0,0,1,1.0034,2.85,115,1,1.06,0.94,
        10,2,153,33,0,0,1,1.0205,1.35,230,1,1.06,0.94,
        11,1,83,21,0,0,1,1.0057,2.46,115,1,1.06,0.94,
        12,1,0,0,0,0,1,0.9974,5.21,230,1,1.06,0.94,
        13,1,58,10,0,0,1,0.9977,-0.55,115,1,1.06,0.94,
        14,1,160,60,0,0,1,0.9991,-4.81,115,1,1.06,0.94,
        15,1,126.7,23,0,0,1,1.0343,-8.59,115,1,1.06,0.94,
        16,1,0,0,0,0,1,1.0315,-2.65,345,1,1.06,0.94,
        17,1,561,220,0,0,1,1.0649,-13.1,115,1,1.06,0.94,
        19,1,0,0,0,0,1,0.982,1.08,230,1,1.06,0.94,
        20,2,605,120,0,0,1,1.001,-2.46,115,1,1.06,0.94,
        21,1,77,1,0,0,1,0.9752,1.62,230,1,1.06,0.94,
        22,1,81,23,0,0,1,0.9963,-1.97,115,1,1.06,0.94,
        23,1,21,7,0,0,1,1.0501,3.94,115,1,1.06,0.94,
        24,1,0,0,0,0,1,1.0057,6.02,230,1,1.06,0.94,
        25,1,45,12,0,0,1,1.0234,1.44,115,1,1.06,0.94,
        26,1,28,9,0,0,1,0.9986,-1.73,115,1,1.06,0.94,
        27,1,69,13,0,0,1,0.975,-4.9,115,1,1.06,0.94,
        33,1,55,6,0,0,1,1.0244,-12.02,115,1,1.06,0.94,
        34,1,0,0,0,0,1,1.0414,-7.94,345,1,1.06,0.94,
        35,1,0,0,0,0,1,0.9757,-25.72,115,1,1.06,0.94,
        36,1,0,0,0,0,1,1.0011,-22.59,230,1,1.06,0.94,
        37,1,85,32,0,0,1,1.0201,-11.23,115,1,1.06,0.94,
        38,1,155,18,0,0,1,1.0202,-12.56,115,1,1.06,0.94,
        39,1,0,0,0,0,1,1.0535,-5.81,345,1,1.06,0.94,
        40,1,46,-21,0,0,1,1.0216,-12.78,115,1,1.06,0.94,
        41,1,86,0,0,0,1,1.0292,-10.45,115,1,1.06,0.94,
        42,1,0,0,0,0,1,1.0448,-7.44,345,1,1.06,0.94,
        43,1,39,9,0,0,1,1.0006,-16.79,115,1,1.06,0.94,
        44,1,195,29,0,0,1,1.0086,-17.47,115,1,1.06,0.94,
        45,1,0,0,0,0,1,1.0215,-14.74,230,1,1.06,0.94,
        46,1,0,0,0,0,1,1.0344,-11.75,345,1,1.06,0.94,
        47,1,58,11.8,0,0,1,0.9777,-23.17,115,1,1.06,0.94,
        48,1,41,19,0,0,1,1.0019,-16.09,115,1,1.06,0.94,
        49,1,92,26,0,0,1,1.0475,-2.95,115,1,1.06,0.94,
        51,1,-5,5,0,0,1,1.0253,-8.15,115,1,1.06,0.94,
        52,1,61,28,0,0,1,0.9979,-11.86,115,1,1.06,0.94,
        53,1,69,3,0,0,1,0.9959,-17.6,115,1,1.06,0.94,
        54,1,10,1,0,0,1,1.005,-16.25,115,1,1.06,0.94,
        55,1,22,10,0,0,1,1.015,-12.21,115,1,1.06,0.94,
        57,1,98,20,0,0,1,1.0335,-8,115,1,1.06,0.94,
        58,1,14,1,0,0,1,0.9918,-5.99,115,1,1.06,0.94,
        59,1,218,106,0,0,1,0.9789,-5.29,115,1,1.06,0.94,
        60,1,0,0,0,0,1,1.0246,-9.56,230,1,1.06,0.94,
        61,1,227,110,0,0,1,0.9906,-3.47,115,1,1.06,0.94,
        62,1,0,0,0,0,1,1.016,-1.1,230,1,1.06,0.94,
        63,2,70,30,0,0,1,0.9583,-17.62,115,1,1.06,0.94,
        64,1,0,0,0,0,1,0.948,-12.97,230,1,1.06,0.94,
        69,1,0,0,0,0,1,0.963,-25.66,115,1,1.06,0.94,
```

```
70,1,56,20,0,0,1,0.9513,-35.16,115,1,1.06,0.94,
71,1,116,38,0,0,1,0.9793,-29.88,115,1,1.06,0.94,
72,1,57,19,0,0,1,0.9696,-27.48,115,1,1.06,0.94,
73,1,224,71,0,0,1,0.9775,-25.77,115,1,1.06,0.94,
74,1,0,0,0,0,1,0.9964,-22,230,1,1.06,0.94,
76,2,208,107,0,0,1,0.9632,-26.54,115,1,1.06,0.94,
77,1,74,28,0,0,1,0.9837,-24.94,115,1,1.06,0.94,
78,1,0,0,0,0,1,0.99,-24.05,115,1,1.06,0.94,
79,1,48,14,0,0,1,0.982,-24.97,115,1,1.06,0.94,
80,1,28,7,0,0,1,0.9872,-24.97,115,1,1.06,0.94,
81,1,0,0,0,0,1,1.034,-18.89,345,1,1.06,0.94,
84,2,37,13,0,0,1,1.025,-17.16,115,1,1.06,0.94,
85,1,0,0,0,0,1,0.9872,-17.68,230,1,1.06,0.94,
86,1,0,0,0,0,1,0.9909,-14.19,230,1,1.06,0.94,
87,1,0,0,0,0,1,0.9921,-7.77,230,1,1.06,0.94,
88,1,0,0,0,0,1,1.0151,-20.96,230,1,1.06,0.94,
89,1,44.2,0,0,0,1,1.0317,-11.13,115,1,1.06,0.94,
90,1,66,0,0,0,1,1.0272,-11.23,115,1,1.06,0.94,
91,2,17.4,0,0,0,1,1.052,-9.4,115,1,1.06,0.94,
92,2,15.8,0,0,0,1,1.052,-6.2,115,1,1.06,0.94,
94,1,60.3,0,0,0,1,0.993,-9.42,115,1,1.06,0.94,
97,1,39.9,0,0,0,1,1.0183,-13.24,115,1,1.06,0.94,
98,2,66.7,0,0,0,1,1,-14.6,115,1,1.06,0.94,
99,1,83.5,0,0,0,1,0.9894,-20.27,115,1,1.06,0.94,
100,1,0,0,0,0,1,1.006,-14.45,115,1,1.06,0.94,
102,1,77.8,0,0,0,1,1.0008,-15.23,115,1,1.06,0.94,
103,1,32,0,0,0,1,1.0288,-12.06,115,1,1.06,0.94,
104,1,8.6,0,0,0,1,0.9958,-17.33,115,1,1.06,0.94,
105,1,49.6,0,0,0,1,1.0223,-12.94,115,1,1.06,0.94,
107,1,4.6,0,0,0,1,1.0095,-16.03,115,1,1.06,0.94,
108,2,112.1,0,0,0,1,0.99,-20.26,115,1,1.06,0.94,
109,1,30.7,0,0,0,1,0.9749,-26.06,115,1,1.06,0.94,
110,1,63,0,0,0,1,0.973,-24.72,115,1,1.06,0.94,
112,1,19.6,0,0,0,1,0.9725,-28.69,115,1,1.06,0.94,
113,1,26.2,0,0,0,1,0.97,-25.38,115,1,1.06,0.94,
114,1,18.2,0,0,0,1,0.9747,-28.59,115,1,1.06,0.94,
115,1,0,0,0,0,1,0.9603,-13.57,115,2,1.06,0.94,
116,1,0,0,0,0,1,1.0249,-12.69,115,2,1.06,0.94,
117,1,0,0,0,325,1,0.9348,-4.72,115,2,1.06,0.94,
118,1,14.1,650,0,0,1,0.9298,-4.12,115,2,1.06,0.94,
119,2,0,0,0,0,1,1.0435,5.17,115,2,1.06,0.94,
120,1,777,215,0,55,1,0.9584,-8.77,115,2,1.06,0.94,
121,1,535,55,0,0,1,0.9871,-12.64,115,2,1.06,0.94,
122,1,229.1,11.8,0,0,1,0.9728,-14.36,115,2,1.06,0.94,
123,1,78,1.4,0,0,1,1.0006,-17.64,115,2,1.06,0.94,
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196,2040,0.0001,0.02,0,0,0,0,1,0,1,-360,360,
119,1190,0.001,0.023,0,0,0,0,1.0223,0,1,-360,360,
120,1200,0,0.023,0,0,0,0,0.9284,0,1,-360,360,
7002,2,0.001,0.0146,0,0,0,0,1,0,1,-360,360,
7003,3,0,0.01054,0,0,0,0,1,0,1,-360,360,
7061,61,0,0.0238,0,0,0,0,1,0,1,-360,360,
7062,62,0,0.03214,0,0,0,0,0.95,0,1,-360,360,
7166,166,0,0.0154,0,0,0,0,1,0,1,-360,360,
7024,24,0,0.0289,0,0,0,0,1,0,1,-360,360,
7001,1,0,0.01953,0,0,0,0,1,0,1,-360,360,
7130,130,0,0.0193,0,0,0,0,1,0,1,-360,360,
7011,11,0,0.01923,0,0,0,0,1,0,1,-360,360,
7023,23,0,0.023,0,0,0,0,1,0,1,-360,360,
7049,49,0,0.0124,0,0,0,0,1,0,1,-360,360,
7139,139,0,0.0167,0,0,0,0,1,0,1,-360,360,
7012,12,0,0.0312,0,0,0,0,1,0,1,-360,360,
7017,17,0,0.01654,0,0,0,0,0.942,0,1,-360,360,
7039,39,0,0.03159,0,0,0,0,0.965,0,1,-360,360,
7057,57,0,0.05347,0,0,0,0,0.95,0,1,-360,360,
7044,44,0,0.18181,0,0,0,0,0.942,0,1,-360,360,
7055,55,0,0.19607,0,0,0,0,0.942,0,1,-360,360,
7071,71,0,0.06896,0,0,0,0,0.9565,0,1,-360,360]

Case300GeneratorCost = [2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.0266666667,20,0,
2,0,0,3,0.064516129,20,0,
2,0,0,3,0.0344827586,20,0,
2,0,0,3,0.147058824,20,0,
2,0,0,3,0.0854700855,20,0,
2,0,0,3,0.00518134715,20,0,
2,0,0,3,0.0416666667,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.0355871886,20,0,
2,0,0,3,0.0143678161,20,0,
2,0,0,3,0.119047619,20,0,
2,0,0,3,0.0460829493,20,0,
2,0,0,3,0.0970873786,20,0,
2,0,0,3,0.0268817204,20,0,
2,0,0,3,0.0462962963,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.0487804878,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.0438596491,20,0,
2,0,0,3,0.119047619,20,0,
2,0,0,3,0.05,20,0,
```

```
2,0,0,3,0.00833333333,20,0,
2,0,0,3,0.00833333333,20,0,
2,0,0,3,0.0210526316,20,0,
2,0,0,3,0.00506842372,20,0,
2,0,0,3,0.0235849057,20,0,
2,0,0,3,0.0367647059,20,0,
2,0,0,3,0.1,20,0,
2,0,0,3,0.0222222222,20,0,
2,0,0,3,0.04,20,0,
2,0,0,3,0.0330033003,20,0,
2,0,0,3,0.0289855072,20,0,
2,0,0,3,0.0333333333,20,0,
2,0,0,3,0.0166666667,20,0,
2,0,0,3,0.04,20,0,
2,0,0,3,0.0181818182,20,0,
2,0,0,3,0.0173783084,20,0,
2,0,0,3,0.0588235294,20,0,
2,0,0,3,0.119047619,20,0,
2,0,0,3,0.0214132762,20,0,
2,0,0,3,0.0160513644,20,0,
2,0,0,3,0.00826446281,20,0,
2,0,0,3,0.0427350427,20,0,
2,0,0,3,0.0268817204,20,0,
2,0,0,3,0.0303030303,20,0,
2,0,0,3,0.0540540541,20,0,
2,0,0,3,0.0243902439,20,0,
2,0,0,3,0.02,20,0,
2,0,0,3,0.27027027,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.222222222,20,0,
2,0,0,3,0.0606060606,20,0,
2,0,0,3,0.025,20,0,
2,0,0,3,0.025,20,0,
2,0,0,3,0.0862068966,20,0,
2,0,0,3,0.00773993808,20,0,
2,0,0,3,0.0142857143,20,0,
2,0,0,3,0.0180831826,20,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.01,40,0,
2,0,0,3,0.2,20,0,
2,0,0,3,1.25,20,0]

Case300BusDF = pd.DataFrame(np.array([Case300Bus[x:x+len(BusTitles)] for
x in range(0, len(Case300Bus), int(len(BusTitles)))]), columns=BusTitles)
display(Case300BusDF)
display(len(Case300Bus)/len(BusTitles))

Case300GeneratorDF = pd.DataFrame(np.array([Case300Generator[x:x+len(Gene
ratorTitles)] for x in range(0, len(Case300Generator), int(len(GeneratorT
itles)))]), columns=GeneratorTitles)
display(Case300GeneratorDF)
display(len(Case300Generator)/len(GeneratorTitles))

Case300BranchDF = pd.DataFrame(np.array([Case300Branch[x:x+len(BranchTitl
es)] for x in range(0, len(Case300Branch), int(len(BranchTitles)))]), col
umns=BranchTitles)
```

```python
display(Case300BranchDF)
display(len(Case300Branch)/len(BranchTitles))

Case300GeneratorCostDF = pd.DataFrame(np.array([Case300GeneratorCost[x:x
+len(GeneratorCostTitles)] for x in range(0, len(Case300GeneratorCost), i
nt(len(GeneratorCostTitles)))]), columns=GeneratorCostTitles)
display(Case300GeneratorCostDF)
display(len(Case300GeneratorCost)/len(GeneratorCostTitles))

Case300BusDF.to_csv('Case 300 Bus.csv', index=False)
Case300GeneratorDF.to_csv('Case 300 Generator.csv', index=False)
Case300BranchDF.to_csv('Case 300 Branch.csv', index=False)
Case300GeneratorCostDF.to_csv('Case 300 Generator Cost.csv', index=False)
```

	Bus ID	Bus Type	Real Power Demand	React Power Demand	Shunt Conductance	Shunt Susceptance	Area	Volt Magnitude	Volt Angle
0	1.0	1.0	90.00	49.00	0.00	0.0	1.0	1.0284	5.95
1	2.0	1.0	56.00	15.00	0.00	0.0	1.0	1.0354	7.74
2	3.0	1.0	20.00	0.00	0.00	0.0	1.0	0.9971	6.64
3	4.0	1.0	0.00	0.00	0.00	0.0	1.0	1.0308	4.71
4	5.0	1.0	353.00	130.00	0.00	0.0	1.0	1.0191	4.68
...	...	...	...	...	...	...	...	...	...
295	9055.0	2.0	0.00	0.00	0.00	0.0	1.0	1.0000	-7.54
296	9071.0	1.0	1.02	0.35	0.05	0.0	1.0	0.9752	-20.48
297	9072.0	1.0	1.02	0.35	0.05	0.0	1.0	0.9803	-19.92
298	9121.0	1.0	3.80	1.25	0.00	0.0	1.0	0.9799	-19.30
299	9533.0	1.0	1.19	0.41	0.10	0.0	1.0	1.0402	-18.24

300 rows × 13 columns

```
300.0
```

	Bus ID	Real Power Output	React Power Output	Max React Power Output	Min React Power Output	Volt Magnitude	mBase	status	Max Real Power Output	Min Real Power Output	..
0	8.0	0.0	0.0	10.00	-10.00	1.0153	100.0	1.0	100.0	0.0	..
1	10.0	0.0	0.0	20.00	-20.00	1.0205	100.0	1.0	100.0	0.0	..
2	20.0	0.0	0.0	20.00	-20.00	1.0010	100.0	1.0	100.0	0.0	..
3	63.0	0.0	0.0	25.00	-25.00	0.9583	100.0	1.0	100.0	0.0	..
4	76.0	0.0	0.0	35.00	12.00	0.9632	100.0	1.0	100.0	0.0	..
...	...	...	...	...	...	...	...	...	...	...	..
64	9002.0	0.0	0.0	2.00	-2.00	0.9945	100.0	1.0	100.0	0.0	..
65	9051.0	0.0	0.0	17.35	-17.35	1.0000	100.0	1.0	100.0	0.0	..
66	9053.0	0.0	0.0	12.83	-12.80	1.0000	100.0	1.0	100.0	0.0	..
67	9054.0	50.0	0.0	38.00	-38.00	1.0000	100.0	1.0	150.0	0.0	..
68	9055.0	8.0	0.0	6.00	-6.00	1.0000	100.0	1.0	108.0	0.0	..

69 rows × 21 columns

```
69.0
```

	From Bus	To Bus	Resistance	Reactance	Susceptance	RateA	RateB	RateC	Ratio	A
0	37.0	9001.0	0.00006	0.00046	0.0	0.0	0.0	75.0	1.0082	
1	9001.0	9005.0	0.00080	0.00348	0.0	0.0	0.0	0.0	0.0000	
2	9001.0	9006.0	0.02439	0.43682	0.0	0.0	0.0	0.0	0.9668	
3	9001.0	9012.0	0.03624	0.64898	0.0	0.0	0.0	0.0	0.9796	
4	9005.0	9051.0	0.01578	0.37486	0.0	0.0	0.0	0.0	1.0435	
...	...	...	...	...	...	...	...	...	...	
406	7039.0	39.0	0.00000	0.03159	0.0	0.0	0.0	0.0	0.9650	
407	7057.0	57.0	0.00000	0.05347	0.0	0.0	0.0	0.0	0.9500	
408	7044.0	44.0	0.00000	0.18181	0.0	0.0	0.0	0.0	0.9420	
409	7055.0	55.0	0.00000	0.19607	0.0	0.0	0.0	0.0	0.9420	
410	7071.0	71.0	0.00000	0.06896	0.0	0.0	0.0	0.0	0.9565	

411 rows × 13 columns

411.0

	Model	Startup Cost	Shutdown Cost	Num Coef	Coef1	Coef2	Coef3
0	2.0	0.0	0.0	3.0	0.01	40.0	0.0
1	2.0	0.0	0.0	3.0	0.01	40.0	0.0
2	2.0	0.0	0.0	3.0	0.01	40.0	0.0
3	2.0	0.0	0.0	3.0	0.01	40.0	0.0
4	2.0	0.0	0.0	3.0	0.01	40.0	0.0
...	...	...	...	...	...	...	...
64	2.0	0.0	0.0	3.0	0.01	40.0	0.0
65	2.0	0.0	0.0	3.0	0.01	40.0	0.0
66	2.0	0.0	0.0	3.0	0.01	40.0	0.0
67	2.0	0.0	0.0	3.0	0.20	20.0	0.0
68	2.0	0.0	0.0	3.0	1.25	20.0	0.0

69 rows × 7 columns

69.0

```python
In [126]: Case300BusDF = pd.DataFrame(np.array([Case300Bus[x:x+len(BusTitles)] for
          x in range(0, len(Case300Bus), int(len(BusTitles)))]), columns=BusTitles)
          new_ids = [x+1 for x in range(0, len(Case300BusDF))]
          Case300BusDF['New Bus ID'] = new_ids
          BusMapDF = Case300BusDF[['Bus ID', 'New Bus ID']]
          Case300BusDF['Bus ID'] = BusMapDF[BusMapDF['Bus ID'].isin(Case300BusDF['B
          us ID'])]['New Bus ID'].values
          display(Case300BusDF)
          display(len(Case300Bus)/len(BusTitles))

          Case300GeneratorDF = pd.DataFrame(np.array([Case300Generator[x:x+len(Gene
          ratorTitles)] for x in range(0, len(Case300Generator), int(len(GeneratorT
          itles)))]), columns=GeneratorTitles)
          Case300GeneratorDF['Bus ID'] = BusMapDF[BusMapDF['Bus ID'].isin(Case300Ge
          neratorDF['Bus ID'])]['New Bus ID'].values
          display(Case300GeneratorDF)
          display(len(Case300Generator)/len(GeneratorTitles))

          Case300BranchDF = pd.DataFrame(np.array([Case300Branch[x:x+len(BranchTitl
          es)] for x in range(0, len(Case300Branch), int(len(BranchTitles)))]), col
          umns=BranchTitles)
          Case300BranchDF['From Bus'] = Case300BranchDF['From Bus'].map(BusMapDF.se
          t_index('Bus ID')['New Bus ID'].to_dict())
          Case300BranchDF['To Bus'] = Case300BranchDF['To Bus'].map(BusMapDF.set_in
          dex('Bus ID')['New Bus ID'].to_dict())
          display(Case300BranchDF)
          display(len(Case300Branch)/len(BranchTitles))

          Case300GeneratorCostDF = pd.DataFrame(np.array([Case300GeneratorCost[x:x
          +len(GeneratorCostTitles)] for x in range(0, len(Case300GeneratorCost), i
          nt(len(GeneratorCostTitles)))]), columns=GeneratorCostTitles)
          display(Case300GeneratorCostDF)
          display(len(Case300GeneratorCost)/len(GeneratorCostTitles))

          Case300BusDF.to_csv('Case 300 Bus.csv', index=False)
          Case300GeneratorDF.to_csv('Case 300 Generator.csv', index=False)
          Case300BranchDF.to_csv('Case 300 Branch.csv', index=False)
          Case300GeneratorCostDF.to_csv('Case 300 Generator Cost.csv', index=False)
```

	Bus ID	Bus Type	Real Power Demand	React Power Demand	Shunt Conductance	Shunt Susceptance	Area	Volt Magnitude	Volt Angle	
0	1	1.0	90.00	49.00	0.00	0.0	1.0	1.0284	5.95	
1	2	1.0	56.00	15.00	0.00	0.0	1.0	1.0354	7.74	
2	3	1.0	20.00	0.00	0.00	0.0	1.0	0.9971	6.64	
3	4	1.0	0.00	0.00	0.00	0.0	1.0	1.0308	4.71	
4	5	1.0	353.00	130.00	0.00	0.0	1.0	1.0191	4.68	
...	...	...	...	...	...	...	...	...	...	
295	296	2.0	0.00	0.00	0.00	0.0	1.0	1.0000	-7.54	
296	297	1.0	1.02	0.35	0.05	0.0	1.0	0.9752	-20.48	
297	298	1.0	1.02	0.35	0.05	0.0	1.0	0.9803	-19.92	
298	299	1.0	3.80	1.25	0.00	0.0	1.0	0.9799	-19.30	
299	300	1.0	1.19	0.41	0.10	0.0	1.0	1.0402	-18.24	

300 rows × 14 columns

300.0

	Bus ID	Real Power Output	React Power Output	Max React Power Output	Min React Power Output	Volt Magnitude	mBase	status	Max Real Power Output	Min Real Power Output	...
0	8	0.0	0.0	10.00	-10.00	1.0153	100.0	1.0	100.0	0.0	...
1	10	0.0	0.0	20.00	-20.00	1.0205	100.0	1.0	100.0	0.0	...
2	19	0.0	0.0	20.00	-20.00	1.0010	100.0	1.0	100.0	0.0	...
3	55	0.0	0.0	25.00	-25.00	0.9583	100.0	1.0	100.0	0.0	...
4	63	0.0	0.0	35.00	12.00	0.9632	100.0	1.0	100.0	0.0	...
...	...	...	...	...	...	...	...	...	...	...	...
64	267	0.0	0.0	2.00	-2.00	0.9945	100.0	1.0	100.0	0.0	...
65	292	0.0	0.0	17.35	-17.35	1.0000	100.0	1.0	100.0	0.0	...
66	294	0.0	0.0	12.83	-12.80	1.0000	100.0	1.0	100.0	0.0	...
67	295	50.0	0.0	38.00	-38.00	1.0000	100.0	1.0	150.0	0.0	...
68	296	8.0	0.0	6.00	-6.00	1.0000	100.0	1.0	108.0	0.0	...

69 rows × 21 columns

69.0

	From Bus	To Bus	Resistance	Reactance	Susceptance	RateA	RateB	RateC	Ratio	Angl
0	31	266	0.00006	0.00046	0.0	0.0	0.0	75.0	1.0082	0.
1	266	270	0.00080	0.00348	0.0	0.0	0.0	0.0	0.0000	0.
2	266	271	0.02439	0.43682	0.0	0.0	0.0	0.0	0.9668	0.
3	266	273	0.03624	0.64898	0.0	0.0	0.0	0.0	0.9796	0.
4	270	292	0.01578	0.37486	0.0	0.0	0.0	0.0	1.0435	0.
...	...	...	...	...	...	...	...	...	...	.
406	255	33	0.00000	0.03159	0.0	0.0	0.0	0.0	0.9650	0.
407	259	49	0.00000	0.05347	0.0	0.0	0.0	0.0	0.9500	0.
408	256	38	0.00000	0.18181	0.0	0.0	0.0	0.0	0.9420	0.
409	258	48	0.00000	0.19607	0.0	0.0	0.0	0.0	0.9420	0.
410	262	59	0.00000	0.06896	0.0	0.0	0.0	0.0	0.9565	0.

411 rows × 13 columns

411.0

	Model	Startup Cost	Shutdown Cost	Num Coef	Coef1	Coef2	Coef3
0	2.0	0.0	0.0	3.0	0.01	40.0	0.0
1	2.0	0.0	0.0	3.0	0.01	40.0	0.0
2	2.0	0.0	0.0	3.0	0.01	40.0	0.0
3	2.0	0.0	0.0	3.0	0.01	40.0	0.0
4	2.0	0.0	0.0	3.0	0.01	40.0	0.0
...	...	...	...	...	...	...	...
64	2.0	0.0	0.0	3.0	0.01	40.0	0.0
65	2.0	0.0	0.0	3.0	0.01	40.0	0.0
66	2.0	0.0	0.0	3.0	0.01	40.0	0.0
67	2.0	0.0	0.0	3.0	0.20	20.0	0.0
68	2.0	0.0	0.0	3.0	1.25	20.0	0.0

69 rows × 7 columns

69.0

```python
In [62]: BusTitles = ['Bus ID', 'Bus Type', 'Real Power Demand', 'React Power Dema
         nd',
                      'Shunt Conductance', 'Shunt Susceptance', 'Area',
                      'Volt Magnitude','Volt Angle', 'Base Volt', 'Zone',
                      'Max Volt Magnitude','Min Volt Magnitude']

         GeneratorTitles = ['Bus ID', 'Real Power Output', 'React Power Output',
                           'Max React Power Output','Min React Power Output',
                           'Volt Magnitude','mBase','status','Max Real Power Outp
         ut',
                           'Min Real Power Output','Pc1','Pc2','Qc1min','Qc1max',
                           'Qc2min','Qc2max','Ramp Rate','10 min Ramp Rate',
                           '30 min Ramp Rate','React Power Ramp Rate','APF']

         BranchTitles = ['From Bus','To Bus','Resistance','Reactance','Susceptanc
         e',
                        'RateA','RateB','RateC','Ratio','Angle','Status',
                        'Min Angle Difference','Max Angle Difference']

         GeneratorCostTitles = ['Model','Startup Cost','Shutdown Cost','Num Coef',
                               'Coef1','Coef2','Coef3']

         X_Titles = ['Real Power Output','React Power Output','Volt Magnitude','Vo
         lt Angle']
         G_Titles = ['Real Power Demand', 'React Power Demand']
         H_Titles = ['Max Real Power Output', 'Min Real Power Output', 'Max React
         Power Output', 'Min React Power Output', 'Max Volt Magnitude', 'Min Volt
         Magnitude']

         n = len(Case14GeneratorDF['Real Power Output'])      # Number of Generator
         s
         m = len(Case14BusDF['Volt Magnitude'])               # Number of Buses

         # Create Generator to Bus ID vector
         id14 = np.concatenate((Case14GeneratorDF['Bus ID'], Case14BusDF['Bus I
         D']), axis=0)
         id57 = np.concatenate((Case57GeneratorDF['Bus ID'], Case57BusDF['Bus I
         D']), axis=0)
         id118 = np.concatenate((Case118GeneratorDF['Bus ID'], Case118BusDF['Bus I
         D']), axis=0)
         id300 = np.concatenate((Case300GeneratorDF['Bus ID'], Case300BusDF['Bus I
         D']), axis=0)

         # Create X vector with elements [P, Q, V, ϑ]
         X14 = np.concatenate((Case14GeneratorDF['Real Power Output'], Case14Gener
         atorDF['React Power Output'], Case14BusDF['Volt Magnitude'], Case14BusDF
         ['Volt Angle']), axis=0)
         # Create f() matrix with elements [a, b, c]
         f_14 = np.concatenate((Case14GeneratorCostDF['Coef1'], Case14GeneratorCos
         tDF['Coef2'], Case14GeneratorCostDF['Coef3']), axis=0)
         # Create G matrix with elements [Pd, Qd]
         G_14 = np.concatenate((Case14BusDF['Real Power Demand'], Case14BusDF['Rea
         ct Power Demand']), axis=0)
         # Create H matrix with elements [max Pg, min Pg, max Qg, min Qg]
         H_14 = np.concatenate((Case14GeneratorDF['Max Real Power Output'], Case14
         GeneratorDF['Min Real Power Output'], Case14GeneratorDF['Max React Power
         Output'], Case14GeneratorDF['Min React Power Output'],
```

```python
                            Case14BusDF['Max Volt Magnitude'], Case14BusDF['Mi
n Volt Magnitude']), axis=0)

'''
# Create X vector with elements [P, Q, V, ϑ]
X57 = np.concatenate((Case57GeneratorDF['Real Power Output'], Case57Gener
atorDF['React Power Output'], Case57BusDF['Volt Magnitude'], Case57BusDF
['Volt Angle']), axis=0)
f_57 = np.concatenate((Case57GeneratorCostDF['Coef1'], Case57GeneratorCos
tDF['Coef2'], Case57GeneratorCostDF['Coef3']), axis=0)
G_57 = np.concatenate((Case57BusDF['Real Power Demand'], Case57BusDF['Rea
ct Power Demand']), axis=0)
H_57 = np.concatenate((Case57GeneratorDF['Max Real Power Output'], Case57
GeneratorDF['Min Real Power Output'], Case57GeneratorDF['Max React Power
Output'], Case57GeneratorDF['Min React Power Output'],
                            Case57BusDF['Max Volt Magnitude'], Case57BusDF['Mi
n Volt Magnitude']), axis=0)

# Create X vector with elements [P, Q, V, ϑ]
X118 = np.concatenate((Case118GeneratorDF['Real Power Output'], Case118Ge
neratorDF['React Power Output'], Case118BusDF['Volt Magnitude'], Case118B
usDF['Volt Angle']), axis=0)
f_118 = np.concatenate((Case118GeneratorCostDF['Coef1'], Case118Generator
CostDF['Coef2'], Case118GeneratorCostDF['Coef3']), axis=0)
G_118 = np.concatenate((Case118BusDF['Real Power Demand'], Case118BusDF
['React Power Demand']), axis=0)
H_118 = np.concatenate((Case118GeneratorDF['Max Real Power Output'], Case
118GeneratorDF['Min Real Power Output'], Case118GeneratorDF['Max React Po
wer Output'], Case118GeneratorDF['Min React Power Output'],
                            Case118BusDF['Max Volt Magnitude'], Case118BusDF
['Min Volt Magnitude']), axis=0)

# Create X vector with elements [P, Q, V, ϑ]
X300 = np.concatenate((Case300GeneratorDF['Real Power Output'], Case300Ge
neratorDF['React Power Output'], Case300BusDF['Volt Magnitude'], Case300B
usDF['Volt Angle']), axis=0)
f_300 = np.concatenate((Case300GeneratorCostDF['Coef1'], Case300Generator
CostDF['Coef2'], Case300GeneratorCostDF['Coef3']), axis=0)
G_300 = np.concatenate((Case300BusDF['Real Power Demand'], Case300BusDF
['React Power Demand']), axis=0)
H_300 = np.concatenate((Case300GeneratorDF['Max Real Power Output'], Case
300GeneratorDF['Min Real Power Output'], Case300GeneratorDF['Max React Po
wer Output'], Case300GeneratorDF['Min React Power Output'],
                            Case300BusDF['Max Volt Magnitude'], Case300BusDF
['Min Volt Magnitude']), axis=0)
'''
```

Out[62]: "\n# Create X vector with elements [P, Q, V, θ]\nX57 = np.concatenate((Case57GeneratorDF['Real Power Output'], Case57GeneratorDF['React Power Output'], Case57BusDF['Volt Magnitude'], Case57BusDF['Volt Angle']), axis=0)\nf_57 = np.concatenate((Case57GeneratorCostDF['Coef1'], Case57GeneratorCostDF['Coef2'], Case57GeneratorCostDF['Coef3']), axis=0)\nG_57 = np.concatenate((Case57BusDF['Real Power Demand'], Case57BusDF['React Power Demand']), axis=0)\nH_57 = np.concatenate((Case57GeneratorDF['Max Real Power Output'], Case57GeneratorDF['Min Real Power Output'], Case57GeneratorDF['Max React Power Output'], Case57GeneratorDF['Min React Power Output'],\n   Case57BusDF['Max Volt Magnitude'], Case57BusDF['Min Volt Magnitude']), axis=0)\n\n# Create X vector with elements [P, Q, V, θ]\nX118 = np.concatenate((Case118GeneratorDF['Real Power Output'], Case118GeneratorDF['React Power Output'], Case118BusDF['Volt Magnitude'], Case118BusDF['Volt Angle']), axis=0)\nf_118 = np.concatenate((Case118GeneratorCostDF['Coef1'], Case118GeneratorCostDF['Coef2'], Case118GeneratorCostDF['Coef3']), axis=0)\nG_118 = np.concatenate((Case118BusDF['Real Power Demand'], Case118BusDF['React Power Demand']), axis=0)\nH_118 = np.concatenate((Case118GeneratorDF['Max Real Power Output'], Case118GeneratorDF['Min Real Power Output'], Case118GeneratorDF['Max React Power Output'], Case118GeneratorDF['Min React Power Output'],\n Case118BusDF['Max Volt Magnitude'], Case118BusDF['Min Volt Magnitude']), axis=0)\n\n# Create X vector with elements [P, Q, V, θ]\nX300 = np.concatenate((Case300GeneratorDF['Real Power Output'], Case300GeneratorDF['React Power Output'], Case300BusDF['Volt Magnitude'], Case300BusDF['Volt Angle']), axis=0)\nf_300 = np.concatenate((Case300GeneratorCostDF['Coef1'], Case300GeneratorCostDF['Coef2'], Case300GeneratorCostDF['Coef3']), axis=0)\nG_300 = np.concatenate((Case300BusDF['Real Power Demand'], Case300BusDF['React Power Demand']), axis=0)\nH_300 = np.concatenate((Case300GeneratorDF['Max Real Power Output'], Case300GeneratorDF['Min Real Power Output'], Case300GeneratorDF['Max React Power Output'], Case300GeneratorDF['Min React Power Output'],\n   Case300BusDF['Max Volt Magnitude'], Case300BusDF['Min Volt Magnitude']), axis=0)\n"

Node Visualization

```python
In [55]:  import networkx as nx
          import matplotlib.pyplot as plt

          # Defining a Class
          class GraphVisualization:

              def __init__(self):

                  # visual is a list which stores all
                  # the set of edges that constitutes a
                  # graph
                  self.visual = []

              # addEdge function inputs the vertices of an
              # edge and appends it to the visual list
              def addEdge(self, a, b):
                  temp = [a, b]
                  self.visual.append(temp)

              # In visualize function G is an object of
              # class Graph given by networkx G.add_edges_from(visual)
              # creates a graph with a given list
              # nx.draw_networkx(G) - plots the graph
              # plt.show() - displays the graph
              def visualize(self):
                  G = nx.Graph()
                  G.add_edges_from(self.visual)
                  plt.figure(3,figsize=(15,15))
                  nx.draw_spring(G,node_size=30,font_size=0)
                  plt.show()

          # Driver code
          G = GraphVisualization()
          for index, row in Case300BranchDF.iterrows():
              G.addEdge(Case300BranchDF['From Bus'][index], Case300BranchDF['To Bu
          s'][index])
          G.visualize()
```
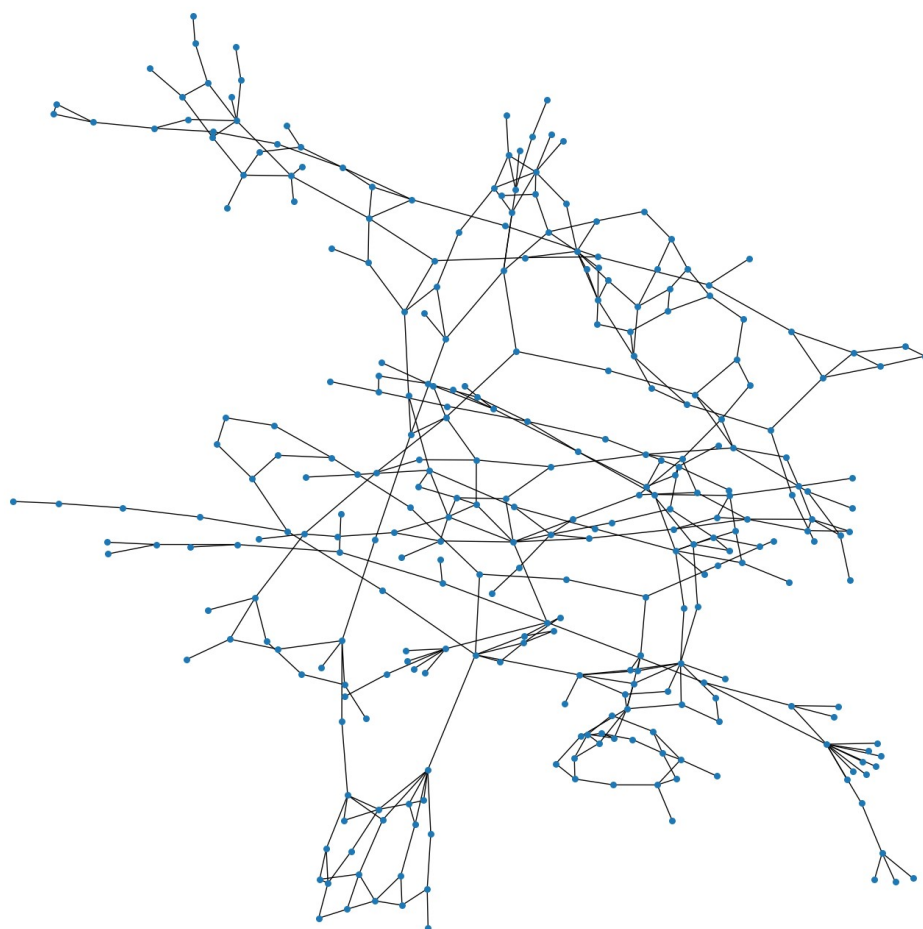
In [127]:
```python
Case14RealPowerDemand = Case14BusDF['Real Power Demand'].sum()
Case14ReactPowerDemand = Case14BusDF['React Power Demand'].sum()

Case57RealPowerDemand = Case57BusDF['Real Power Demand'].sum()
Case57ReactPowerDemand = Case57BusDF['React Power Demand'].sum()

Case118RealPowerDemand = Case118BusDF['Real Power Demand'].sum()
Case118ReactPowerDemand = Case118BusDF['React Power Demand'].sum()

Case300RealPowerDemand = Case300BusDF['Real Power Demand'].sum()
Case300ReactPowerDemand = Case300BusDF['React Power Demand'].sum()

print(Case14RealPowerDemand)
print(Case14ReactPowerDemand)

print(Case57RealPowerDemand)
print(Case57ReactPowerDemand)

print(Case118RealPowerDemand)
print(Case118ReactPowerDemand)

print(Case300RealPowerDemand)
print(Case300ReactPowerDemand)
```

```
259.0
73.5
1250.8
336.4
4242.0
1438.0
23525.85
7787.97
```

In [157]:
```python
NumCases = [2, 4, 10, 25]

Case14REGDF = Case14GeneratorDF[['Bus ID', 'Max Real Power Output', 'Min Real Power Output', 'Max React Power Output', 'Min React Power Output']]
Case14REGDF = Case14REGDF.tail(NumCases[0])
Case14REGDF = pd.concat([Case14REGDF]*1024, ignore_index=True)
Case14REGDF['Real Power Output'] = [np.random.randint(min, max) for min,max in zip(Case14REGDF['Min Real Power Output'], Case14REGDF['Max Power Output'])]
Case14REGDF['React Power Output'] = [np.random.randint(min, max) for min,max in zip(Case14REGDF['Min React Power Output'], Case14REGDF['Max React Power Output'])]
Case14GeneratorDFMinusREG = Case14GeneratorDF.head(len(Case14GeneratorDF)-NumCases[0])
Case14GeneratorCostDFMinusREG = Case14GeneratorCostDF.head(len(Case14GeneratorCostDF)-NumCases[0])

Case14REGDF.to_csv('Case 14 REG.csv', index=False)
Case14GeneratorDFMinusREG.to_csv('Case 14 Generator.csv', index=False)
Case14GeneratorCostDFMinusREG.to_csv('Case 14 Generator Cost.csv', index=False)


Case57REGDF = Case57GeneratorDF[['Bus ID', 'Max Real Power Output', 'Min Real Power Output', 'Max React Power Output', 'Min React Power Output']]
Case57REGDF = Case57REGDF.tail(NumCases[1])
Case57REGDF = pd.concat([Case57REGDF]*1024, ignore_index=True)
Case57REGDF['Real Power Output'] = [np.random.randint(min, max) for min,max in zip(Case57REGDF['Min Real Power Output'], Case57REGDF['Max Real Power Output'])]
Case57REGDF['React Power Output'] = [np.random.randint(min, max) for min,max in zip(Case57REGDF['Min React Power Output'], Case57REGDF['Max React Power Output'])]
Case57GeneratorDFMinusREG = Case57GeneratorDF.head(len(Case57GeneratorDF)-NumCases[1])
CCase57GeneratorCostDFMinusREG = Case57GeneratorCostDF.head(len(Case57GeneratorCostDF)-NumCases[1])
CCase57GeneratorCostDFMinusREG

Case57REGDF.to_csv('Case 57 REG.csv', index=False)
Case57GeneratorDFMinusREG.to_csv('Case 57 Generator.csv', index=False)
CCase57GeneratorCostDFMinusREG.to_csv('Case 57 Generator Cost.csv', index=False)


Case118REGDF = Case118GeneratorDF[['Bus ID', 'Max Real Power Output', 'Min Real Power Output', 'Max React Power Output', 'Min React Power Output']]
Case118REGDF = Case118REGDF.tail(NumCases[2])
Case118REGDF = pd.concat([Case118REGDF]*1024, ignore_index=True)
Case118REGDF['Real Power Output'] = [np.random.randint(min, max) for min,max in zip(Case118REGDF['Min Real Power Output'], Case118REGDF['Max Real Power Output'])]
Case118REGDF['React Power Output'] = [np.random.randint(min, max) for min,max in zip(Case118REGDF['Min React Power Output'], Case118REGDF['Max Re
```

```python
act Power Output'])]
Case118GeneratorDFMinusREG = Case118GeneratorDF.head(len(Case118Generator
DF)-NumCases[2])
Case118GeneratorCostDFMinusREG = Case118GeneratorCostDF.head(len(Case118G
eneratorCostDF)-NumCases[2])
Case118GeneratorCostDFMinusREG

Case118REGDF.to_csv('Case 118 REG.csv', index=False)
Case118GeneratorDFMinusREG.to_csv('Case 118 Generator.csv', index=False)
Case118GeneratorCostDFMinusREG.to_csv('Case 118 Generator Cost.csv', inde
x=False)




Case300REGDF = Case300GeneratorDF[['Bus ID', 'Max Real Power Output', 'Mi
n Real Power Output', 'Max React Power Output', 'Min React Power Outpu
t']]
Case300REGDF = Case300REGDF.tail(NumCases[3])
Case300REGDF = pd.concat([Case300REGDF]*1024, ignore_index=True)
Case300REGDF['Real Power Output'] = [np.random.randint(min, max) for mi
n,max in zip(Case300REGDF['Min Real Power Output'], Case300REGDF['Max Rea
l Power Output'])]
Case300REGDF['React Power Output'] = [np.random.randint(min, max) for mi
n,max in zip(Case300REGDF['Min React Power Output'], Case300REGDF['Max Re
act Power Output'])]
Case300GeneratorDFMinusREG = Case300GeneratorDF.head(len(Case300Generator
DF)-NumCases[3])
Case300GeneratorCostDFMinusREG = Case300GeneratorCostDF.head(len(Case300G
eneratorCostDF)-NumCases[3])
Case300GeneratorCostDFMinusREG

Case300REGDF.to_csv('Case 300 REG.csv', index=False)
Case300GeneratorDFMinusREG.to_csv('Case 300 Generator.csv', index=False)
Case300GeneratorCostDFMinusREG.to_csv('Case 300 Generator Cost.csv', inde
x=False)
```

In [168]:
```python
R = 'Resistance'
X = 'Reactance'

Case14BranchDF['G'] = round(Case14BranchDF[R] / (Case14BranchDF[R]**2 + C
ase14BranchDF[X]**2), 3)
Case14BranchDF['B'] = round(Case14BranchDF[X] / (Case14BranchDF[R]**2 + C
ase14BranchDF[X]**2), 3)
Case14BranchDF.to_csv('Case 14 Branch.csv', index=False)




Case57BranchDF['G'] = round(Case57BranchDF[R] / (Case57BranchDF[R]**2 + C
ase57BranchDF[X]**2), 3)
Case57BranchDF['B'] = round(Case57BranchDF[X] / (Case57BranchDF[R]**2 + C
ase57BranchDF[X]**2), 3)
Case57BranchDF.to_csv('Case 57 Branch.csv', index=False)




Case118BranchDF['G'] = round(Case118BranchDF[R] / (Case118BranchDF[R]**2
+ Case118BranchDF[X]**2), 3)
Case118BranchDF['B'] = round(Case118BranchDF[X] / (Case118BranchDF[R]**2
+ Case118BranchDF[X]**2), 3)
Case118BranchDF.to_csv('Case 118 Branch.csv', index=False)



Case300BranchDF['G'] = round(Case300BranchDF[R] / (Case300BranchDF[R]**2
+ Case300BranchDF[X]**2), 3)
Case300BranchDF['B'] = round(Case300BranchDF[X] / (Case300BranchDF[R]**2
+ Case300BranchDF[X]**2), 3)
Case300BranchDF.to_csv('Case 300 Branch.csv', index=False)
```