Putu Andika Eka Putra (Pu an di) F11127807

Power system operation and control
Homework # 3 . 2022/11/16

I inputed the load as follows.

```
basemva = 100; accuracy = 0.0001; maxiter = 100;

busdata=[1  1     1.03  0.0   0     0     0     0     0     50    0
         2  2     1.04  0.0   20    10    80    0     0     250   0
         3  0     1.00  0.0   25    15    0     0     0     0     1
         4  0     1.00  0.0   10    5     0     0     0     0     3
         5  0     1.00  0.0   40    20    0     0     0     0     0
         6  0     1.00  0.0   60    40    0     0     0     0     0
         7  2     1.01  0.0   10    5     120   0     0     100   0
         8  0     1.00  0.0   80    60    0     0     0     0     0
         9  0     1.00  0.0   100   80    0     0     0     0     0];

linedata=[1      2      0.018   0.054     0.0045      1
          1      8      0.014   0.036     0.0030      1
          2      9      0.006   0.030     0.0028      1
          2      3      0.013   0.036     0.0030      1
          3      4      0.010   0.050     0.0000      1
          4      5      0.018   0.056     0.0000      1
          5      6      0.020   0.060     0.0000      1
          6      7      0.015   0.045     0.0038      1
          6      9      0.002   0.066     0.0000      1
          7      8      0.032   0.076     0.0000      1
          7      9      0.022   0.065     0.0000      1];


cost=[240   6.7   0.009
      220   6.1   0.005
      240   6.5   0.008];

mwlimits=[50      200
          50      200
          50      100];
```

I run the initial power flow analysis with newton-raphson method and save the out put in a txt file.

```
diary HW3_1stlineflow.txt
Lfybus
Lfnewton
Busout
diary off
```

the command resulting the following output.

```
                Power Flow Solution by Newton-Raphson Method
                   Maximum Power Mismatch = 1.79641e-05
                          No. of Iterations = 3

 Bus  Voltage  Angle    ------Load------    ---Generation---   Injected
 No.  Mag.     Degree     MW       Mvar       MW       Mvar       Mvar

  1   1.030    0.000     0.000     0.000   150.433     9.887     0.000
  2   1.040   -2.301    20.000    10.000    80.000   202.151     0.000
  3   1.019   -3.082    25.000    15.000     0.000     0.000     1.000
  4   1.004   -3.759    10.000     5.000     0.000     0.000     3.000
  5   0.988   -4.141    40.000    20.000     0.000     0.000     0.000
  6   0.991   -3.376    60.000    40.000     0.000     0.000     0.000
  7   1.010   -1.637    10.000     5.000   120.000    33.467     0.000
  8   1.001   -1.289    80.000    60.000     0.000     0.000     0.000
  9   1.004   -3.100   100.000    80.000     0.000     0.000     0.000

 Total                 345.000   235.000   350.433   245.505     4.000
```

In the next phase use while loop to get the optimal dispatch of the generation and store the dpslack and totalcost in an array/matrix.

```
diary HW3_optimaldispatch.txt
dpsiter = 1;
fprintf("\n\n interation NO : %i",dpsiter);
fprintf("\n_____________________")
Bloss
Gencost
Dispatch
dpslackLim = 0.001;
dpsdata =dpslack;
costdata =totalcost;
while dpslack > dpslackLim
    dpsiter = dpsiter+1;
    fprintf("\n\n interation NO : %i",dpsiter);
    fprintf("\n_____________________")
    Lfnewton
```

```
        Bloss
        Dispatch
        Gencost
        dpsdata =[dpsdata dpslack];
        costdata =[costdata totalcost];

    end
    diary off
```

the command resulting the following output.

```
 interation NO : 1
_____________________
B =

    0.0108    0.0011   -0.0006
    0.0011    0.0308   -0.0010
   -0.0006   -0.0010    0.0078


B0 =

   1.0e-03 *

    0.0143    0.2625    0.0096


B00 =

   1.4232e-06

Total system loss = 5.41477 MW

Total generation cost =    3326.77 $/h
Incremental cost of delivered power
(system lambda) =  8.585979 $/MWh
Optimal Dispatch of Generation:

   93.4509
  161.2246
  100.0000

Total system loss = 9.67561 MW

Absolute value of the slack bus real
power mismatch, dpslack =   0.5698 pu


 interation NO : 2
_____________________
B =

    0.0120    0.0013   -0.0007
    0.0013    0.0092   -0.0009
   -0.0007   -0.0009    0.0082


B0 =

   1.0e-03 *

    0.0662    0.1113    0.0120


B00 =

   1.4243e-06

Total system loss = 4.12665 MW
Incremental cost of delivered power
(system lambda) =  8.164874 $/MWh
Optimal Dispatch of Generation:

   71.9980
  179.3813
   97.9426

Total system loss = 4.32194 MW

Absolute value of the slack bus real
power mismatch, dpslack =   0.1592 pu

Total generation cost =    3197.52 $/h


 interation NO : 3
_____________________
B =

    0.0133    0.0014   -0.0007
    0.0014    0.0080   -0.0008
   -0.0007   -0.0008    0.0082


B0 =
```

```
   1.0e-04 *

    0.9491    0.9575    0.1204


B00 =

   1.4247e-06

Total system loss = 4.02054 MW
Incremental cost of delivered power
(system lambda) =  8.152344 $/MWh
Optimal Dispatch of Generation:

   70.4917
  181.3638
   97.1862

Total system loss = 4.04165 MW

Absolute value of the slack bus real
power mismatch, dpslack =   0.0122 pu

Total generation cost =    3195.07 $/h


 interation NO : 4
_____________________
B =

    0.0135    0.0014   -0.0007
    0.0014    0.0078   -0.0008
   -0.0007   -0.0008    0.0082


B0 =

   1.0e-04 *

    0.9761    0.9427    0.1219


B00 =

   1.4247e-06

Total system loss = 4.01647 MW
Incremental cost of delivered power
(system lambda) =  8.151350 $/MWh
Optimal Dispatch of Generation:

   70.3503
  181.5573
   97.1107

Total system loss = 4.01826 MW

Absolute value of the slack bus real
power mismatch, dpslack =   0.0013 pu

Total generation cost =    3194.87 $/h


 interation NO : 5
_____________________
B =

    0.0135    0.0014   -0.0007
    0.0014    0.0078   -0.0008
   -0.0007   -0.0008    0.0082


B0 =

   1.0e-04 *

    0.9788    0.9413    0.1220


B00 =

   1.4247e-06

Total system loss = 4.01613 MW
Incremental cost of delivered power
(system lambda) =  8.151257 $/MWh
Optimal Dispatch of Generation:

   70.3366
  181.5760
   97.1034

Total system loss = 4.01605 MW

Absolute value of the slack bus real
power mismatch, dpslack =   0.0002 pu

Total generation cost =    3194.85 $/h
Elapsed time is 0.087033 seconds.
```

And display the final output with the following command.

```
diary HW3_finalsolution.txt
Busout
Gencost
Lineflow
diary off
```

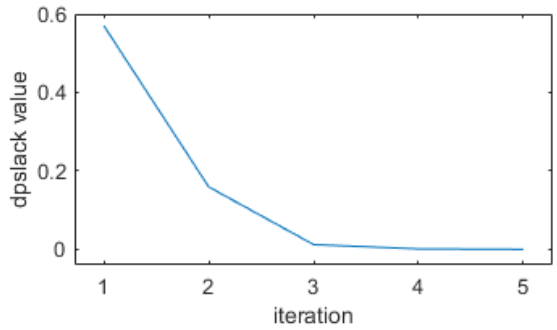
Here are the output.

```
                  Power Flow Solution by Newton-Raphson Method
                    Maximum Power Mismatch = 1.55071e-08
                          No. of Iterations = 2

    Bus  Voltage  Angle     ------Load------     ---Generation---   Injected
    No.  Mag.     Degree      MW       Mvar       MW       Mvar       Mvar

     1   1.030    0.000      0.000     0.000    70.360    35.459     0.000
     2   1.040   -0.142     20.000    10.000   181.557   169.819     0.000
     3   1.019   -1.066     25.000    15.000     0.000     0.000     1.000
     4   1.004   -1.937     10.000     5.000     0.000     0.000     3.000
     5   0.988   -2.554     40.000    20.000     0.000     0.000     0.000
     6   0.992   -2.046     60.000    40.000     0.000     0.000     0.000
     7   1.010   -0.738     10.000     5.000    97.111    36.642     0.000
     8   1.001   -1.006     80.000    60.000     0.000     0.000     0.000
     9   1.005   -1.426    100.000    80.000     0.000     0.000     0.000

    Total                 345.000   235.000   349.028   241.919     4.000
```

```
Total generation cost =    3194.85 $/h

                          Line Flow and Losses

    --Line--  Power at bus & line flow    --Line loss--  Transformer
    from  to    MW      Mvar     MVA       MW      Mvar      tap

    1         70.360   35.459   78.790
          2   -1.300  -19.112   19.156    0.059   -0.787
          8   71.661   54.571   90.073    1.075    2.146

    2        161.557  159.819  227.251
          1    1.360   18.325   18.376    0.059   -0.787
          9   98.775  103.158  142.821    1.135    5.090
          3   61.423   38.336   72.405    0.633    1.117

    3        -25.000  -14.000   28.653
          2  -60.790  -37.219   71.279    0.633    1.117
          4   35.790   23.219   42.662    0.175    0.876

    4        -10.000   -2.000   10.198
          3  -35.615  -22.342   42.043    0.175    0.876
          5   25.615   20.342   32.710    0.191    0.594

    5        -40.000  -20.000   44.721
          4  -25.424  -19.748   32.193    0.191    0.594
          6  -14.576   -0.252   14.578    0.044    0.131

    6        -60.000  -40.000   72.111
          5   14.620    0.382   14.625    0.044    0.131
          7  -57.723  -21.210   61.497    0.575    0.963
          9  -16.896  -19.172   25.555    0.013    0.438

    7         87.111   31.642   92.679
          6   58.298   22.172   62.372    0.575    0.963
          8    9.461    7.686   12.190    0.047    0.111
          9   19.352    1.783   19.434    0.081    0.241

    8        -80.000  -60.000  100.000
          1  -70.585  -52.425   87.924    1.075    2.146
          7   -9.415   -7.575   12.084    0.047    0.111

    9       -100.000  -80.000  128.062
          2  -97.640  -98.068  138.387    1.135    5.090
          6   16.910   19.611   25.894    0.013    0.438
          7  -19.270   -1.543   19.332    0.081    0.241

   Total loss                             4.028   10.919
```

To get better look on the process I run this command to plot the improvement in each iteration.

```
figure('Position', [1, 1, 400, 800])
tiledlayout(2,1)

nexttile
plot(1:dpsiter,dpsdata);
xlabel("iteration")
ylabel("dpslack value")
axis padded
nexttile
plot(1:dpsiter,costdata);
xlabel("iteration")
ylabel("totalcost")
axis padded
```



the simulation show the Total generation cost is 3194.85 $/h and power mismatch, dpslack = 0.0002 pu achieved after 5 iteration.