Problem 1

Completion of MILP Formulation

Variables:

There are 14 variables in my generator model problem: x1, x2, x3, x4, x5, x6, x7, x8,x9,x10,x11,x12,x13,x14. They are defined as given below:

Variable	**Definition**
x1	G1 Accepted Quantity 20 MW Step
x2	G1 Accepted Quantity 30 MW Step
x3	G1 Accepted Quantity 15 MW Step
x4	G1 = x1 + x2 + x3 or total MW to be bid by G1
x5	G2 Indicator Variable
x6	G2 Indicator Variable
x7	G2 Indicator Variable
x8	G2 Indicator Variable
x9	G2 Variable
x10	G2 Variable
x11	G2 Variable
x12	G2 = x5 + x6 + x7 + x8 + x9 + x10 + x11 or total MW to be accepted by G2
x13	Unit commitment status of G1
x14	Unit commitment status of G2

Objective Function:

The objective of the problem is to minimize cost of combined bids of both generators.

$$\min \sum (20 \times x1) + (25 \times x2) + (30 \times x3) + (x5 \times 200) + (x6 \times 620) + (x7 \times 1660) + (x8 \times 2460)$$
$$+ (28 \times x9) \quad + (26 \times x10) \quad + (32 \times x11) + (x13 \times 100) + (x14 \times 200)$$

The objective function is the sum of the unit price of the MW multiplied by the quantity to be accepted added to the other ranges and their respective products plus the no-load cost.

Note: In the MATLAB portion of the model, the x4 and x12 variables are set equal to 0 since it is not in the problem definition to minimize these.

Constraints

The constraints of the problem are shown below:

$$x1 + x2 + x3 = x4$$
$$x4 + x12 = 60$$
$$x = \delta_0 \times 0 + \delta_1 \times 15 + \delta_2 \times 55 + \delta_3 \times 80 + z_1 + z_2 + z$$
$$y = \delta_0 \times 200 + \delta_1 \times 620 + \delta_2 \times 1660 + \delta_3 \times 2460 + 28z_1 + 26z_2 + 32z_3$$
$$\delta_0 + \delta_1 + \delta_2 + \delta_3 = \delta$$
$$z_1 - 15\delta_0 \le 0$$
$$z_2 - 40\delta_1 \le 0$$
$$z_3 - 25\delta_2 \le 0$$
$$15x13 \le x4 \le 65x13$$
$$10x14 \le x12 \le 80x14$$

Bounds

The bounds of the model are defined in the problem statement and are shown below:

Variable	Lower Bound	Upper Bound
x1	0	20
x2	0	30
x3	0	15
x4	15	65
x5	0	1
x6	0	1
x7	0	1
x8	0	1
x9	0	Inf
x10	0	Inf
x11	0	Inf
x12	10	80
x13	0	1
x14	0	1

MATLAB CODE

```
% Week 4 Assignment
% Kathleen Williams
% Set Input data

% Objective Function
f = [20 25 30 0 200 620 1660 2460 28 26 32 0 100 200]';

% Quantity
Aeq = [1 1 1 -1 0 0 0 0 0 0 0 0 0 0;
```

```
      0 0 0 0 1 1 1 1 1 1 1 1 -1 0 0;
      0 0 0 1 0 0 0 0 0 0 0 1 0 0];
beq = [0 0 60]';

lb = [0 0 0 0 0 0 0 0 0 0 0 0 0 0]';
ub = [20 30 15 65 1 1 1 1 inf inf inf 80 1 1]';

A = [0 0 0 0 15 0 0 0 -1 0 0 0 0 0;
     0 0 0 0 0 40 0 0 0 -1 0 0 0 0;
     0 0 0 0 0 0 25 0 0 0 -1 0 0 0;
     0 0 0 1 0 0 0 0 0 0 0 0 -15 0;
     0 0 0 0 0 0 0 0 0 0 0 1 0 -10;
     0 0 0 -1 0 0 0 0 0 0 0 0 65 0;
     0 0 0 0 0 0 0 0 0 0 0 -1 0 80];
A = -A;
 b = [0 0 0 0 0 0 0]';

xint=[0 0 0 0 1 1 1 1 0 0 0 0 1 1]'; %specifying whether a variable is integer: 1->integer, 0->continuous

% call MIP solver
[x,fval,exitflag,output,lambda]=mipprog(f,A,b,Aeq,beq,lb,ub,xint);


% Output results
%1. Optimal solution
x
%2. Objective function value
fval
%3. Shadow price for inequality constraints
lambda.ineqlin
%4. Reduced cost for lower bounds and upper bounds
lambda.lower
lambda.upper
```

MATLAB RESULTS

```
EDU>> week4prob1

x =

   20
   30
   10
   60
    0
    0
    0
    0
    0
    0
    0
    0
    1
    0


fval =

       1550
```