University of Tabriz

Faculty of Electrical and Computer Engineering

Fourth HW, Optimization in Power Systems Course Due date: May 25, 2016

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1. Solve the following bilevel problem using KKT method.

$$\begin{aligned} \text{minimize}_{x,y} \quad & x - 2y \\ \text{subject to} \quad & -x + 3y - 4 \leq 0, \end{aligned}$$

where y, for each value of x, is the solution of:

$$\begin{aligned} \text{minimize}_{y} \quad & x + y \\ \text{subject to} \quad & x - y \leq 0, \\ & -x - y \leq 0. \end{aligned}$$

Change the upper level constraint to the following and solve it using dual method.

$$\begin{aligned} -x + 3y - 4 &\leq 0, \\ -y + \tfrac{1}{2} &\leq 0, \end{aligned}$$

2. Solve the following bilvel problem using KKT method.

$$\min_x x + 3y$$
$$s.t. 1 \le x \le 6,$$

$$\min_y -y$$
$$s.t. \quad x + y \le 8,$$
$$x + 4y \ge 8,$$
$$x + 2y \le 13$$

3. Two thermal units have the following characteristics:

Fuel cost functions:

$$C_1(P_1) = 83 + 6.2P_1 + 0.021P_1^2 \qquad \$/\text{MWh}$$
$$C_2(P_2) = 120.75 + 7.5P_2 + 0.045P_2^2 \qquad \$/\text{MWh}$$

Emission functions:

$$E_1(P_1) = 0.009\,P_1^{\,2} + 3.0\,P_1 + 12 \;\; kg/hr$$
$$E_2(P_2) = 0.005\,P_2^{\,2} + 3.89\,P_2 + 14 \;\; kg/hr$$

$$80 \le P_1 \le 400$$
$$60 \le P_2 \le 300$$

The total load is 560 MW.

a) Find the production of each unit to minimize the total cost.
b) Find the production of each unit to minimize the total emission.
c) Find the production of each unit to minimize cost and emission simultaneously using epsilon-constraint method. Use fuzzy satisfying method to select the best compromise solution. Two objectives are equally important.