

Homework 2, Due Monday Feb 4, 2008

1. Assume that the fuel inputs R_1 and R_2 , in MBTU/hour for units 1 and 2, respectively, are a function of unit MW output powers P_1 and P_2 , respectively, and are given as

$$R_1 = 8P_1 + 0.024P_1^2 + 80$$

$$R_2 = 6P_2 + 0.044P_2^2 + 120$$

The minimum and maximum loadings for both units are 20 MW and 100 MW, respectively. All of the following plots should be given as a function of unit output power.

- Plot the input-output curve for each unit.
 - Plot the heat rate curves for each unit.
 - Plot efficiency for each unit.
 - Plot the incremental heat rate curves for each unit.
 - Assume the cost of fuel is \$2/MBTU. Plot the cost-rate curves for each unit.
 - Plot the incremental cost-rate curves for each unit.
2. A system consists of two generators supplying a load. Generators 1 and 2 cost curves (\$/hr) are as indicated below:

$$C_1(P_{g1}) = 0.02(P_{g1})^2 + 2.0(P_{g1})$$

$$C_2(P_{g2}) = 0.03(P_{g2})^2 + (P_{g2})$$

and limits of:

$$10 \text{ MW} \leq P_{g1} \leq 100 \text{ MW}$$

$$30 \text{ MW} \leq P_{g2} \leq 100 \text{ MW}$$

- In this system, when the load is 140 MW, what is the dispatch of these two units?
 - In this system, when the load is 190 MW, what is the dispatch of these two units?
 - In this system, under a certain economically dispatched scenario (a scenario different than in part (a) and (b)), it is found that supplying an additional 1 MW costs an additional \$5.68/hr. Determine P_{g1} and P_{g2} .
3. We established a procedure in class for solving a minimization problem with multiple equality constraints and one inequality constraint. Consider the situation where we have a minimization problem with multiple equality constraints and multiple inequality constraints. Describe a procedure for solving this problem.
4. As in our example 1 and 2 of the notes called "Intro to Economics: Consumer Surplus," let $v(x) = 60x - x^2$, with $p = 60 - 2x$ and $x(p) = 30 - \frac{p}{2}$. Recall that in example 2, we computed the consumer surplus at $p=30$, $x=15$, to be 225.
- How much energy is obtained when $p=40$?
 - Compute the consumer surplus when the price is 40.
 - What is the change in consumer surplus when the price is raised from 30 to 40?
 - Determine the loss due to buying the new amount of energy at the higher price. If the consumer loses this amount of money, who gets it?
 - Determine the decreased utility due to the decreased purchased amount.
 - Draw a graph of the inverse demand function and illustrate on it:
 - The loss due to buying the new amount of energy at the higher price;
 - The decreased utility due to the decreased purchased amount;
 - The consumer surplus at the higher price.