

# Assignment 6

EE 553 Power System Economics

Due May 17th, 2017 at 8pm. Email to ywang11@uw.edu

**Problem 1.** A firm is considering the construction of a new power plant in addition to the 50 MW power plant it already operates in a region. Possible capacities of the new power plant are 50, 100, and 150 MW. The marginal cost of production of the existing plant and the new plant is 25 \$/MWh. Assume the following:

- There is one competitor in the market, operating at 200 MW generation capacity.
- The incremental cost of operation of the generation capacity of its competitor is 30 \$/MWh.
- The demand can be represented by the demand curve  $\pi = 450 - D$  where  $D$  is the total demand and  $\pi$  is the market price.

1. Determine the capacity of the new plant that would maximize the total operating profit of the firm (that is, should it be 50, 100, or 150 MW?). What is the total operating profit? Assume that the plant must make 6000 \$/h to cover its fixed costs. What is the net profit after accounting for the fixed cost?
2. What happens to the profit of the competitor once the new power plant is constructed?
3. Because of some changes in the market, the new demand curve becomes  $\pi = 440 - 1.2D$ . What happens to the net profit of constructing the new plant (again assume 6000\$/h is needed to cover the fixed cost). This shows that decisions can be very sensitive to the estimate of the prices.

**Problem 2.** Consider a market for electrical energy that is supplied by two generating companies whose cost functions are:

$$C_A = 36P_A$$

$$C_B = 31P_B$$

where  $P_A$  and  $P_B$  are the generations. The inverse demand curve for this market is:

$$\pi = 120 - D$$

where  $D$  is the total demand.

Under the Cournot model of competition, find the equilibrium production for each company and their respective profits.

**Problem 3.** 1. Consider the following network in Fig. 1: Suppose 100 MW of power is

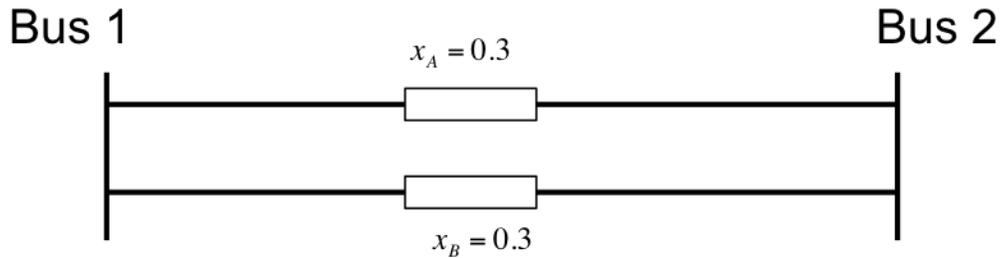


Figure 1: Network for 3.1

sent from bus 1 to bus 2. How much of it flows on each edge?

2. Consider the following network in Fig. 2:

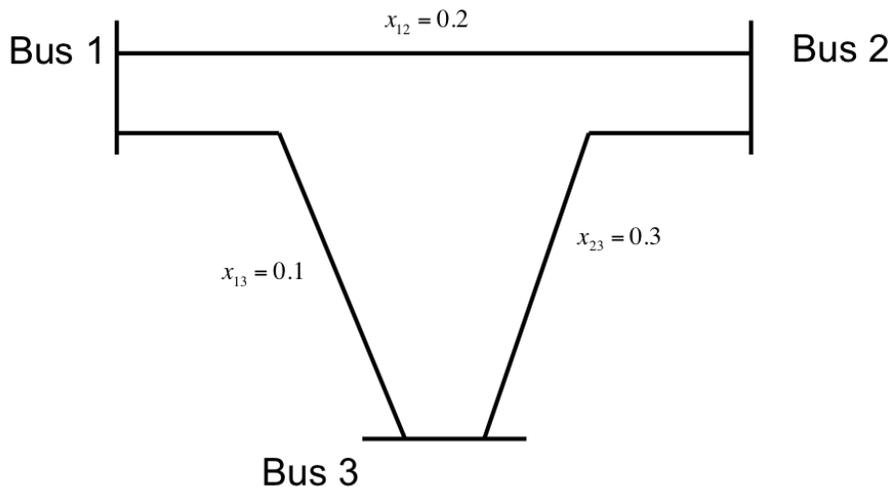


Figure 2: Network for 3.2

Suppose 100 MW of power is to be transferred from bus 2 to bus 3. How much of it flows on each edge? Identify the direction of power flow.

3. Consider the following network in Fig. 3:

Suppose 100 MW of power is transferred from bus 1 to bus 3, where 40 MW flows on the line from 1 to 3 and 60 MW flows from 1 to 2 then to 3. Find the unknown reactance  $x_{12}$ .

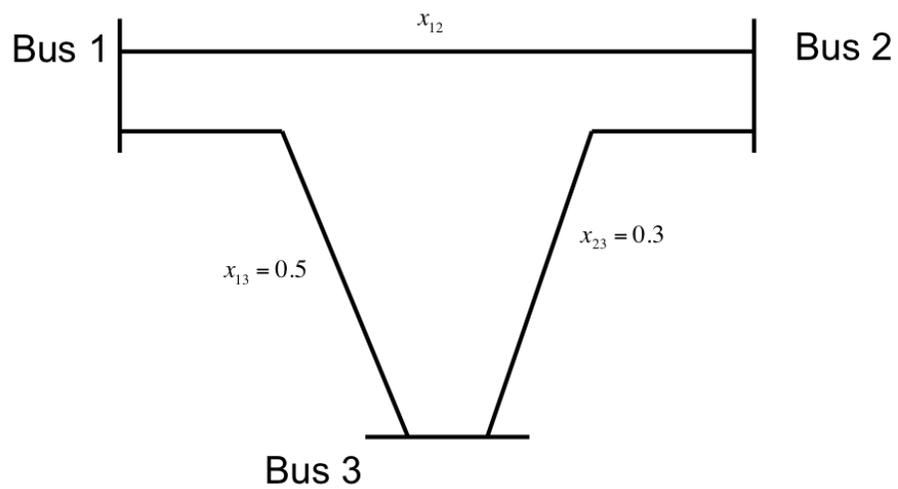


Figure 3: Network for 3.3