ECON 180 - Regulation & Antitrust Policy
Drake University, Spring 2015
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Signature: _____

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TEST 11 VERSION A
"Regulation of Electric Power"

INSTRUCTIONS: This exam is closed-book, closed-notes. Simple calculators are permitted, but graphing calculators or calculators with alphabetical keyboards are NOT permitted. Mobile phones or other wireless devices are NOT permitted. Points will be subtracted for illegible writing or incorrect rounding. Point values for each question are noted in brackets.

I. Problems: Insert your answer to each question below in the box provided. Feel free to use the margins for scratch work—only the answers in the boxes will be graded. Work carefully—partial credit is not normally given for questions in this section.

(1) [Traditional ROR regulation: 15 pts] Suppose a public utility's price is set by traditional rate-of-return regulation. This utility has plant and equipment valued at $50,000 and annual expenses of $7,000.

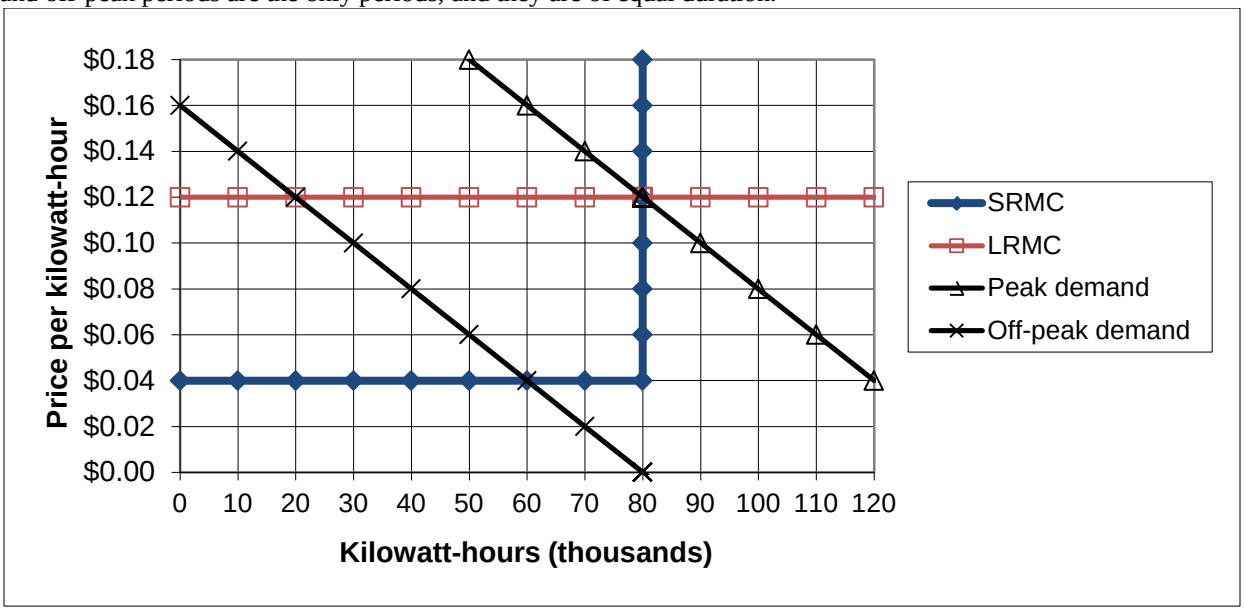
a. Compute the utility's *rate base*. $

Suppose the regulator determines that the utility's allowed rate of return is 6% and the demand for the utility's product is given by $Q = 2000\ P^{-1/2}$, where Q denotes quantity demanded and P denotes the price, set by the regulator.

b. Compute the utility's *revenue requirement*. $

c. What price should the regulator set? $

(2) [Peak-load pricing: 33 pts] Suppose cost and demand for electricity are given by the following graph. Costs are shown as short-run marginal cost (SRMC) and long-run marginal cost (LRMC) curves. LRMC includes the cost of building new capacity. Demands are shown as peak demand and off-peak demand. Assume for simplicity that peak and off-peak periods are the only periods, and they are of equal duration.



a. Explain in words why SRMC bends up vertically at 80 thousand kilowatt hours.

First, suppose efficient peak-load pricing is used.

b. Find the price of electricity during the peak period.	$ per kWh
c. Find the quantity of electricity demanded during the peak period.	thousand kWh
d. Find the price of electricity during the off-peak period	$ per kWh
e. Find the quantity of electricity demanded during the off-peak period.	thousand kWh

Now suppose instead a uniform price of **$ 0.10** per kilowatt-hour is used in both peak and off-peak periods.

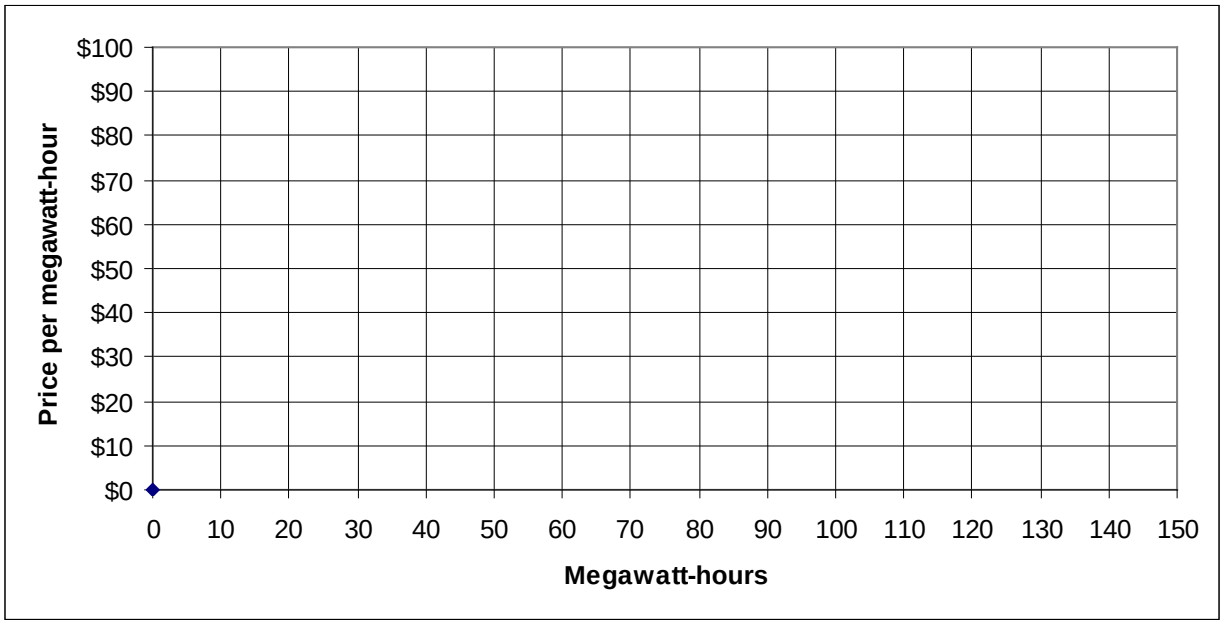
f. Find the quantity of electricity demanded during the peak period.	thousand kWh
g. Find the quantity of electricity demanded during the off-peak period.	thousand kWh
h. Would generation capacity have to *increase*, *decrease*, or *stay the same* to accommodate uniform pricing?	
i. By how much? (Give the required *change* in generation capacity.)	thousand kWh
j. In the graph above, shade the areas representing social deadweight loss from uniform pricing.	
k. Compute the social deadweight loss from uniform pricing.	$ thousand

(3) [Wholesale power markets, economic dispatch: 20 pts] Suppose you manage the Regional Transmission Organization (RTO) for a power grid and you have received the following four "asks" from power suppliers ("generators") for the hour ending 10 AM:

- Generator A: 60 megawatt-hours at $20 per megawatt-hour.
- Generator B: 40 megawatt-hours at $30 per megawatt-hour.
- Generator C: 30 megawatt-hours at $10 per megawatt-hour.
- Generator D: 10 megawatt-hours at $40 per megawatt-hour.

and the following three "bids" from power demanders ("loads") for the same hour:

- Load #1: 50 megawatt-hours at $90 per megawatt-hour.
- Load #2: 40 megawatt-hours at $60 per megawatt-hour.
- Load #3: 30 megawatt-hours at $80 per megawatt-hour.



a. [4 pts] Plot and label demand and supply curves for these asks and bids.
b. [8 pts] Given these asks and bids, what amount of power will you order each generator to supply?

Generator A	megawatt-hours
Generator B	megawatt-hours
Generator C	megawatt-hours
Generator D	megawatt-hours

c. [4 pts] What price for electric power will you set for this hour?

$	per megawatt-hour

d. [4 pts] Suppose an unexpected event (increased demand or failure of a generator) requires you to find another megawatt-hour of power. Which generator will you call on to deliver that extra power?

(4) [Sources of market power: 20 pts] According to the model of "dominant-firm price leadership," the dominant firm's residual elasticity of demand is given by the formula

$$|\varepsilon_{DF}| = \frac{|\varepsilon_M| + (1 - S_{DF})\beta_{CF}}{S_{DF}}$$

where ε_{DF} denotes the residual elasticity of demand faced by the dominant firm, ε_M denotes the total market elasticity of demand, S_{DF} denotes the market share of the dominant firm, and β_{CF} denotes the elasticity of supply of the "competitive fringe" of other suppliers.

Consider the application of this formula to the market for wholesale electric power, where the "dominant firm" is an individual power generator (possibly small), and the "competitive fringe" consists of all other power generators in the same market.

First, suppose the market elasticity of demand = $|\varepsilon_M| = 0.093$, the individual power generator's market share = $S_{DF} = 0.05$, and the elasticity of supply of all other power generators = $\beta_{CF} = 0.06$.

a. Compute the absolute value of the individual power generator's elasticity of demand ($|\varepsilon_{DF}|$) to three significant digits.

b. Compute the individual power generator's price-cost margin (or Lerner index) to three significant digits.

Second, consider the effect of the following policy changes.

Suppose more generators join the wholesale electricity market.

c. Which parameter in the formula ($|\varepsilon_M|$, S_{DF} , or β_{CF}) changes?

d. Does that parameter *increase* or *decrease* ?

e. Does the absolute value of the individual power generator's elasticity of demand ($|\varepsilon_{DF}|$) *increase, decrease,* or remain *constant?*

f. Does the individual power generator's price-cost margin (or Lerner index) *increase, decrease,* or remain *constant?*

Suppose real-time pricing is imposed on *retail* electricity customers.

g. Which parameter in the formula ($|\varepsilon_M|$, S_{DF} , or β_{CF}) changes?

h. Does that parameter *increase* or *decrease* ?

i. Does the absolute value of the individual power generator's elasticity of demand ($|\varepsilon_{DF}|$) *increase, decrease,* or remain *constant?*

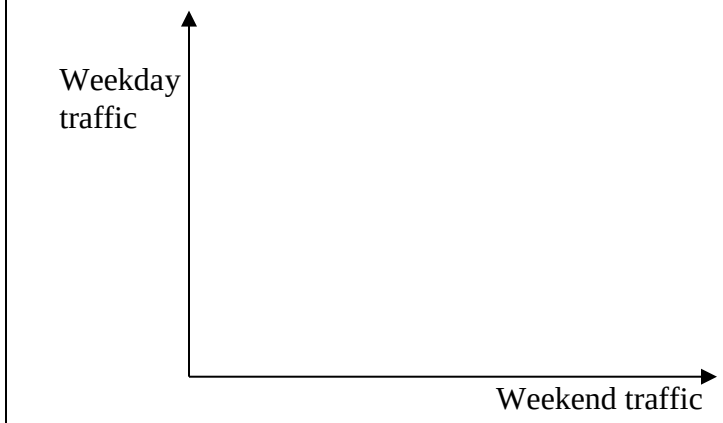
j. Does the individual power generator's price-cost margin (or Lerner index) *increase, decrease,* or remain *constant?*

II. Critical thinking [12 pts]

Bridges are expensive to construct, so often the money to pay for their construction is recovered through tolls. In big cities, bridges are intensively used on weekdays (Monday-Friday) but only lightly used on weekends (Saturday-Sunday).

a. Are bridges a *joint cost* or a *common cost* [i] for weekday traffic and weekend traffic? Why? Justify your answer and illustrate it with a production-possibility curve.

b. Assume that the government wants to set tolls so as that price equals marginal cost. Should the cost of bridge construction be included in weekday tolls only, in weekend tolls only, or both? Why?



[end of quiz]

[i] Use Kahn's definitions of *common cost* and *joint costs*. Alfred E. Kahn, *The Economics of Regulation: Principles and Institutions*, Volume 1, New York: Wiley, 1970, pp.78-79.