



STUDYDADDY

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Instructions

- This problem set is **due Wednesday, February 8, in class**.
- Please submit a legible paper copy of your write-up and **staple** multiple pages together.
- Please indicate your name at the top of the first page of your submission.
- You are allowed to work together with your classmates, but each of you is expected to submit a complete and independent write-up.
- Please justify all your answers. Merely stating the final result without any explanation is not sufficient for full credit, even if your answer is correct.

Problem 1

A power company can develop a hydroelectric project at one of two capacity levels, one megawatt or two megawatts, at the cost of \$1 billion or \$1.75 billion, respectively. The costs of construction are being incurred immediately in either case. If the smaller capacity is chosen, it is not possible to increase capacity at a later date.

The company can sell a capacity of one megawatt on a contractual basis for a net revenue of \$200 million per year, with payments beginning three years from today and lasting forever.

Another buyer is willing to commit to purchasing the second megawatt of power (in case the power company decides to invest in the extra capacity) for \$300 million per year in perpetuity, but only starting eleven years from now.

Find the net present value of the project for each capacity level if the interest rate is 5%. Should the power company invest in 0, 1, or 2 megawatts of capacity?

Problem 2

(a) Compute the limit of the following sequence as $n \rightarrow \infty$:

$$a_n = \frac{8n^4 + 6n^3 - 2n^2 + n - 5}{-2n^4 + 13n^3 - 20n^2 - n - 12}.$$

(b) Consider the sequence

$$a_t = \frac{1}{7^t} \quad \text{for } t = 1, 2, 3, \dots$$

Compute the limit of the corresponding series as $n \rightarrow \infty$:

$$s_n = \sum_{t=1}^n a_t.$$

Problem 3

Your advice is sought on evaluating two policy proposals, each of which combines the effects of an income-support plan with an income-tax program. Let x denote earned income before any taxes or government transfers and let y denote income after taking all taxes and government transfers into account.

Plan A An individual who earns no income ($x = 0$) receives a tax-free government support of \$6,000 annually. No income support is received by anyone with positive earned income ($x > 0$). Those individuals who earn income in excess of \$6,000 are required to pay income tax at the rate of 20% on each dollar earned in excess of \$6,000.

Plan B Everyone receives a basic income of \$6,000 from the government. Each person then pays income tax at the rate of 40% for every dollar of earned income (that is, not including the basic income of \$6,000).

- (a) Compute income after taxes and transfers y as a function of earned income x for each of the two plans, and graph both functions on the same diagram.
- (b) Which tax system is more favorable from the taxpayer's point of view? How does your answer depend on the individual's level of earned income?

Problem 4

Firm 1 and firm 2 produce the same good for a market according to Bertrand's model of price competition. They set prices p_1 and p_2 , respectively. The firm that offers the lower price captures the entire market. If they charge the same price, then they share the market equally.

Assume that market demand is determined by the function $y = 50 - p$. Each firm faces the same cost function $C(y) = 10y$, implying a constant per-unit cost of \$10.

- (a) For a generic fixed price level $\bar{p}_2 > 10$ charged by firm 2, compute firm 1's profits $\pi_1(p_1)$ as a function of the price p_1 set by firm 1. Sketch the graph of this profit function schematically. Is there any point at which the profit function is discontinuous?
- (b) In equilibrium, what price will each firm charge? How many units will *each* firm sell?



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