ECON 331: Environmental Economics

Homework 3

- Define any variables you need to answer the problems.
- Use any materials to help you with these questions. That includes others in this course!
- Please write your answers in the space provided.
- Keep your answers short but clear. Your goal is to convince a skeptical grader that you understand the relevant concepts well enough to answer the question you are given.
- The questions on this homework sum to 62 points. But you get a 100 for completing/attempting the majority of the questions.
- Remember to write down the names of anyone you worked with on this homework!
- Bring any and all questions to office hours!

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1. (4 points) What is your name and who did you work with (if anyone)?

1 True/False Questions

Indicate "T"rue or "F"alse for each of the following statements or claims. For each false statement, if you explain why it is false I will give you a bonus point.

2. (2 points) Suppose the population was perfectly patient, meaning each person would be indifferent between receiving $100 today and $100 any period in the future. **Claim**: The discount rate (and the interest rate) derived from these preferences would be infinite.

3. (2 points) Ben and Jerry are trying to figure out if it's worth it for them to build a new ice cream processing facility in Binghamton. The construction would take 5 years and cost $200 million. When the plant opens at the start of year 6, the plant would increase profits by $50 million in each year until Ben and Jerry shut down the plant in year 20. At that point, Ben and Jerry will have to pay $5 million to demolish the building. Ben uses the net-present value (NPV) method and calculates the net present value is greater than 0. Jerry says he used the LAC method and calculated the plant is not worth building. **Claim**: Either Ben or Jerry has done their calculation incorrectly.

4. (2 points) Imagine Diana has a choice. She can either receive a $109 three periods from now. Or, she can receive a bond worth $100 that for three years pays her $3 per year. At the end of the third year, she also receives the $100 worth of the bond. Assume she chooses the option to maximize the present value of her choice. **Claim**: if the discount rate is 10%, Diane will chose the bond.

5. (2 points) **Claim**: For any positive integer (greater than 0), the PV of any future positive amount in any future period will be lower if you calculate PV using continuous discounting compared to if you use discrete discounting.

6. (2 points) Suppose Bill is trying to save time on his Econ test, and is working on a cost analysis problem. He notices that in the problem all the costs are paid up-front, and the benefits accrue later. He also notices that the sum of future benefits (without discounting them to calculate their present value) is higher than the sum of the costs (also without discounting them to calculate their present value). **Claim**: Bill would be correct in assuming that the benefits would outweigh the costs *solely* because the sum of benefits outweight the sum of the costs.

2 Multiple Choice Questions

Circle the best answer to each question. There is only one answer for each question. No explanation necessary.

7. (2 points) Suppose you are calculating whether or not it makes economic sense (benefits¿costs) to install higher flood walls along the Chenango river in downtown Binghamton. For this project, the costs are paid immediately, with benefits accruing in future periods. Now suppose you uses NPV and calculate that the costs outweigh the benefits by $1. Which of the following, if true, would lead you to conclude the benefits actually outweigh the costs?

    A. The true costs are actually higher than the costs used in the calculation.

    B. The true benefits are actually lower than the benefits used in the calculation.

    C. The interest rate you used is actually higher than the interest rate you used in the calculation.

    D. The interest rate you used is actually lower than the interest rate you used in the calculation.

8. (2 points) Use the information from question 7. Which of the following, if true, would make you feel more confident that the project did not make economic sense, or that the costs really do outweigh the benefits?

    A. The flood walls will not last as long as initially anticipated.

    B. Climate change means these walls will need additional costly mainteance and upgrades in the future.

    C. You used discrete present value discounting, but your manager really wanted you to use continuous time discounting.

    D. All of the above.

9. (2 points) Suppose Hayley is deciding if she should buy a new laptop or not for the upcoming semester. She would spend $1000 on a new Mac today. She expects that it would last for 10 years. By using a newer computer, Hayley expects to derive a benefit of $150 in each year she has the Mac. **Question**: What is the highest discount rate (assume discount rates are only integers) above which it no longer makes economic sense for Hayley to buy the Mac?

    A. 4%.

    B. 6%.

    C. 8%.

    D. 10%.

10. (2 points) Use the information from question 9. Suppose that the interest rate is 4%. Which of the following, if true, would result in Hayley's present value of costs being higher than her present value of benefits of the new Mac?

    A. Nothing, it is already not worth it for Hayley at 4%.

    B. She realized her Mac would only last until the end of year 7.

    C. She realized she only values the benefit of her Mac at $125 each year.

    D. Her Mac cost $1200 instead of $1000.

11. (2 points) Yi is working on a cost-benefit problem for his architecture firm to decide if it is worth investing in additional training for the architects on staff. The training program is a 3-year commitment, meaning Yi has to pay costs in year 0, 1, and 2. Afterwards the staff is more productive, increasing revenue at the firm for the ten years after the completion of the program. Yi decides to use the LCF method for his cost-benefit analysis. As a shortcut, he adds the costs from all three years together (without discounting the costs in years 1 and 2), and then correctly calculates the LCF using this combined cost. He calculates that the benefits outweigh the costs. **Question**: Because Yi did not calculate the present value of the costs in years 1 and 2, Yi _____ the costs relative to if he had done discounting. Relative to discounting, Yi therefore _____ the true net benefit (benefits-costs) of the project.

    A. overestimated, underestimated.

    B. overestimated, overestimated.

    C. underestimated, underestimated.

    D. underestimated, overestimated.

3 Short Answer Questions

These questions all require an explanation. Remember you are trying to convince me you understand the why and the how of what you are doing, not simply getting the answer correct. Cite specific concepts from class in your answers for full credit.

12. **Optimal Pollution Policies Revisited**. Suppose you and a team of economists are designing stricter regulations for new air pollution standards for AI data centers. Using a MAC-MDF diagram, you determine the total abatement cost of the new standard is $5 million each year starting when the policy is enacted (call this year 0) and lasting for two years (year 0 and year 1). Starting in year 2, there are two sets of benefits. First, the value of reducing greenhouse gas emissions has a benefit of $2 million per year. This benefit happens every year afterwards forever. Second, there is more water available for drinking (not being used to cool the data centers) for the 10 years after the policy (years 2 through 11). This benefit is $1 million in each of these years. There is a monitoring cost in period 5 and period 10. This monitoring cost is $500,000 in both periods.

    (a) (4 points) Draw a timeline clearly indicating the benefits and costs of this new regulation. No explanation needed.

    (b) (8 points) For each cost and benefit, write down an equation which you could use to find the present value of each cost and benefit if the discount rate in the economy is r%.

(c) (6 points) Suppose the discount rate in the economy is 3%. Find the net-present value of this regulation. Would it pass a cost-benefit analysis? Why or why not?

(d) (12 points) Now instead use the LAC method with an interest rate of 3% to calculate the net-benefits of the regulation. How does it compare to your answer when you used net-present value? Show your work.

(e) (4 points) Explain whether or not using LAC or NPV changes the qualitative conclusion of the cost-benefit analysis of any regulation.

(f) (4 points) If the interest rate decreased to 1%, how would the net-benefit of the regulation change? Explain the intuition, you do not need to recalculate the net-benefits of the regulation to receive full credit for the explanation.