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## Final Exam

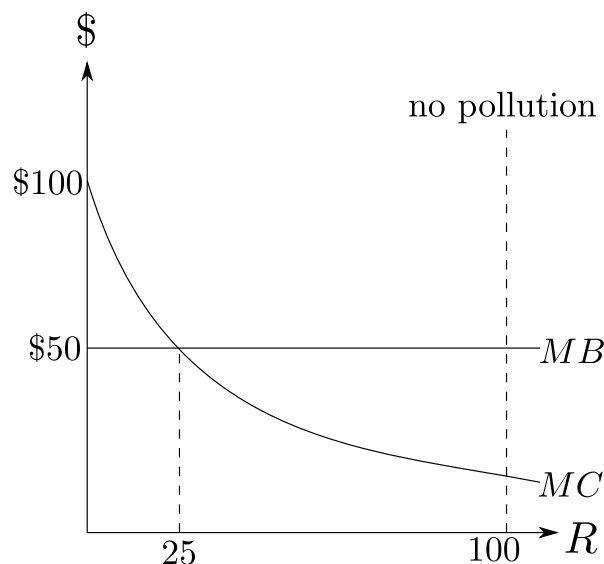
You have two hours to complete this exam. Please include your start time and stop time on your exam. Completed exams should be emailed to me (jparman@wm.edu). Time taken to scan and email answers does not count against your two hours. You can combine graphs and written answers in a single file or use one file for written answers and a second for graphs. If you choose to use multiple files, please send them in a single email.

Answer all questions completely but concisely. Including additional incorrect information in an otherwise correct answer may result in the loss of points. As a rough guide, each five points on the exam typically requires about two sentences to correctly answer. The exam is open notes and open book. You may use your notes, the textbook and any of the materials posted on our course Blackboard site. Other materials are not permitted. Good luck!

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1. (25 points) Think about three of the ways we have considered establishing the value of a statistical life: estimating the present value of expected lifetime earnings, using contingent valuation surveys asking about willingness to pay for risk reductions, and inferring a value of life from compensating wage differentials for risky jobs. We discussed these specifically in the context of the United States. Suppose we used these techniques to estimate the value of a statistical life in a developing country with a low GDP per capita relative to the US, higher infant mortality rates than the US and lower life expectancies than the US.
  - (a) How would you expect the value of a statistical life for this developing country to differ from the value in the US under each of the three methods of calculating the value? Be certain to justify your answers.
  - (b) Given your answers in part (a), how might efficient product and workplace safety regulations differ in the developing country compared to the regulations we have discussed for the US?

2. (25 points) When considering pollution reductions, we have been assuming that the marginal costs of pollution abatement are increasing, with each additional unit of abatement contributing more to total abatement costs than the previous unit. Suppose that a factory actually gets better at reducing pollution as it does more abatement. The firm would therefore have decreasing marginal costs of abatement. This situation is depicted on the graph below with pollution reductions on the horizontal axis and costs and benefits measured on the vertical axis. Note that in the absence of any reductions, the firm produces 100 units of pollution.



- (a) We have typically found the efficient level of pollution reductions by finding the intersection of the marginal benefit and marginal cost curves. Would this level of reductions (25 units on the graph above) be the efficient level of reductions in this case? If so, explain why. If not, explain what the efficient level of reductions would be.
- (b) Suppose that we used a fine to achieve pollution reductions. We set the fine at \$50 per unit of pollution, the marginal benefit of a unit of pollution reduction. On the graph above, show the total amount the firm will choose to spend on pollution reductions and the total amount the firm will choose to spend on fines. Does the use of a fine lead to the efficient outcome?
- (c) Now suppose that instead of fines, we decide to use tradeable permits to achieve pollution reductions. There are two firms, both with the same marginal cost curve shown above. Suppose we initially allocate 75 pollution credits to firm *A* and 25 pollution credits to firm *B*. Explain what you expect to happen in terms of trading of permits between *A* and *B*. Be as specific as possible about the prices at which permits will trade, the direction they will be traded in, and the final allocation of permits between the two firms.

3. (25 points) The  $SO_2$  allowance trading program was undertaken at the federal level. In class, we briefly discussed the California cap and trade program, a similar program intended to curb greenhouse gas emissions that was focused only on the state of California.
- (a) Why might a federal cap and trade program for greenhouse gas emissions achieve more efficient levels of pollution abatement than leaving regulation efforts to the states?
  - (b) Why might state-level cap and trade programs for greenhouse gas emissions achieve more efficient levels than regulating at the federal level?
  - (c) How would your answers to parts (a) and (b) change if the cap and trade programs related to a pollutant that only had very local effects?

4. (25 points) Williamsburg is considering changing its noise ordinance. Residents have complained that parties are creating too much noise in residential neighborhoods. The city is going to introduce a new permit system for all gatherings of more than ten people to help limit the problem. Any person who applies for a permit will get one but has to pay a fee.
- (a) Suppose that college students have positive but diminishing marginal benefits from hosting parties. Drinks, food and all other party supplies always cost the same amount for each party. On a graph with number of parties on the horizontal axis show the marginal benefit and marginal cost curves for a student considering how many parties to host. On this graph, label the number of parties the student would choose to host before the new permit plan is put into place.
  - (b) Suppose that the neighbors dislike parties and get increasingly exacerbated with the noise, so each party has a bigger marginal impact on the neighbors than the previous one. On your graph, show the social marginal cost curve.
  - (c) On your graph, label the optimal fee for a permit assuming that the city council wants to maximize total surplus. Explain in words why this is the optimal fee.
  - (d) On your graph, show the total amount Williamsburg will collect in permit fees.
  - (e) So far, we have only considered the party thrower's benefits and the costs of both the party thrower and the neighbors. However, the people attending each party also benefit from the party. Describe how the optimal fee and the number of parties would change if the city council took these additional benefits into account.