Solutions to Assignment #3 for **Environmental and Resource Economics**
Economics 359M, Spring 2017

Due date: Wednesday, March 22, 2017

Readings: Chapters 7 and 8 in

Kolstad. *Environmental Economics, 2'nd ed.* OUP.

T. Gayer and R. W. Hahn. Designing environmental policy: lessons from the regulation of mercury emissions. *Journal of Regulatory Economics*, 30(3):291–315, 2006.

P. R. Portney. Trouble in Happyville. *Journal of Policy Analysis and Management*, 11(1):131–132, 1992.

R. Costanza, R. D'Arge, R. De Groot, S. Farber, M. Grasso, B. Hannon, K. Limburg, S. Naeem, V. O'Neill, Robert, J. Paruelo, R. G. Raskin, P. Sutton, and D. B. Van. The value of the world's ecosystem services and natural capital. *Nature*, 387(6630):253–260, 1997.

Demand for Environmental Goods

A. Kolstad, Ch. 7, problem 4.

Ans. There are many possible answers, below are some reasonable possibilities. (1) The use of the area for commercial fishing must be stopped or lessened until the area and the fish stocks recover, lost profits are direct damages. (2) Use value is lost for recreational sailors, not a loss of profit because they were not doing it for profit. (Techniques for putting a dollar value on these losses are the reason for this Chapter.) (3) Use value is lost for beach goers of all types, painters, tide-poolers, surfers, sun worshippers. (4) Nonuse value is lost to locals who care about the existence of a healthy ocean and wildlife even if they do not go to use it themselves. (5) Sympathizers away from the area might feel the same way, altruistically.

About this last point, someone who has read the "Trouble in Happyville" author might ask, "But what if the disaster is not covered by the media and only the locals know about it?"

B. Kolstad, Ch. 7, problem 5.

Ans. (a) The budget is $\{(A,H) : A = 2, 2 \cdot H \leq 10\}$, the utility maximal point is $(2,5)$, yielding a utility of 10. (b) The budget is now $\{(A,H) : A = 4, 2 \cdot H \leq 10\}$, the utility maximal point is $(4,5)$, yielding a utility of 20.

(c) The general method covered in lecture passes through the value function: with prices p and wealth w, the parametrized value function is

$$V(p,w;\theta) = \max_{x \geq 0} u(x;\theta) \text{ s.t. } px \leq w.$$

Here the parameter is A (for air quality), and x is H (for housing), utility is $u(H, A) = H \cdot A$, the price is $p = 2$, and $w = 10$. Solving the maximization problem

$$V(p, w; A) = \max_{H \geq 0} H \cdot A \text{ s.t. } p \cdot H \leq w$$

gives $H^*(p, w; A) = w/p$, putting this back into the objective function gives the value function, $V(p, w; A) = A \cdot \frac{w}{p}$. The initial situation is $p = 2$, $w = 10$ and $A = 2$, and we are considering a change to $A' = 4$. Solve for w' such that

$$V(p, w'; A') = V(p, w; A), \text{ that is } 4 \cdot \frac{w'}{2} = 10,$$

which yields $w' = 5$. The dollar value of the shift to $(w, A) = (10, 4)$ therefore $10 - 5 = 5$. To put it another way, Jose would be just as happy at $A = 4$ with 5 less income.

Another way we covered this topic, albeit more briefly, passed through the expenditure functions. With the same notation as above,

$$e(p, u^\circ; \theta) = \min_{x \geq 0} px \text{ s.t. } u(x; \theta) \geq u^\circ.$$

Jose starts with a utility of 10 when $\theta = 2$, and achieving this utility takes $w = 10$. We want to find the minimal expenditure necessary to give him utility 10 when $\theta = 2$ switches to $\theta' = 4$. Solving for the expenditure function yields $e(p, u^\circ; A) = p \cdot \frac{u^\circ}{A}$, plugging in $p = 2$, $u^\circ = 10$ and $A' = 4$, $e(2, 10; 4) = 2 \cdot \frac{10}{4} = 5$. Once again, we have arrived at the conclusion that Jose only needs an income of 5 to achieve his old utility when $A = 2$ shifts to $A' = 4$. His previous income was 10, thus we would be willing to give up (that is, pay) 5 of that in order to have $A = 4$.

Hedonic Pricing

C. Kolstad, Ch. 8, problem 1.

Ans. The affected land is 0.1% of the total in the valley, $5km^2/5{,}000km^2$. A reasonable guess is that this 1/10 of one percent will not affect other prices or wages. We would expect the price, either sale or rental, of the affected land to increase because it becomes more productive. So long as there are no other beneficial effects from cleaning this parcel, and so long as the market is working well, the increased market value should reflect all of the benefits.

D. Kolstad, Ch. 8, problem 2.

Ans. From the graphs, you should find that people's willingness to pay for pollution reduction increases as the level of pollution increases.

E. Kolstad, Ch. 8, problem 3.

Ans. With all of these assumptions, yes, she does have enough information to identify the typicaly marginal willingness to pay function. Reason as follows: the people are identical, hence, in equilibrium, and this is where I get to check that you are learning one of the crucial parts of 'thinking like an economist,' they must be indifferent between living with the pollution where they are and moving; their choice behavior in the marketed good reveals the value they place on the amenity, cleaner air; further, since everyone is identical, the second curve from the previous problem represents everyone's willingness to pay (because the average of identical things is that thing).

F. Kolstad, Ch. 8, problem 6.

Ans. (a) The data would need to include the sales prices of and features relevant to market value. This includes, but is not limited to, horsepower and torque curve, braking power, mechanical reliability, steering technologies, sound system, inside and outside finish. (b) One possibility is to run a linear regression, with p_i denoting the sales price of car i in the data set, f_i its fuel economy, and X_i its other characteristics, find the β_0, β_1, and β_X to best fit

$$p_i = \beta_0 + \beta_1 f_i + \beta_X X_i + \epsilon_i.$$

Rewriting this is useful, at least for perspective,

$$\epsilon_i = (p_i - [\beta_0 + \beta_1 f_i + \beta_X X_i]).$$

The usual way to find the "best fit" is to solve the minimization problem

$$\min_{\beta_0,\beta_1,\beta_X} \sum_i (p_i - [\beta_0 + \beta_1 f_i + \beta_X X_i])^2.$$

(c) As in the text and in lecture, turning this into a marginal willingness to pay is, in general, difficult. In this linear regression approach we have **assumed**, ahead of time, that there is a single number, β_1, that gives the dependence of p_i on f_i — irrespective of the other features of the car, X_i. One might believe that people who buy high end luxury cars care less about what they spend on gas, this would mean that the β_1 slope in that region of the data should be smaller.

Your class in econometrics will spend a great deal of time on such considerations.

On the readings

G. These next questions refer to the Gayer and Hart article (2006 J. Regul. Econ.).

(1) How large is the estimated cost savings to achieving the given level of mercury reduction using the cap-and-trade versus the regulatory approach?

Ans. (a) You only need to look at the abstract for this one, $15 billion.

(2) In lecture, we analyzed the efficiency of cap-and-trade programs as consequences of the equalization of marginal costs of reduction across different sources. Unlike those analyses of cap-and-trade programs, the authors discuss

flexibility not only across sources, but across time. Why might this provide additional savings to society? What margins are being equalized with this that were not considered in lecture?

Ans. In lecture, cap and trade programs equalized the present marginal costs of reduction. In dynamic contexts, one might know, or be reasonably certain, that marginal costs of future reduction will be lower. When the amount of this lowering differs across firms, present equalization of marginal costs may not imply equalization across future marginal costs.

(3) The authors base their estimates of benefits by valuing the decline in babies' IQ's. How were these estimates derived? How does the choice of discount rate affect the estimates?

Ans. See Table 3. The essential difference is that the technology specification approach imposes cost up front while the cap and trade allows the industry, its engineers, and the scientists working on pollution, to devise cheaper methods of reduction. The reduction in up-front costs matters more as the discount factor, $1/(1+r)$, becomes smaller (i.e. as $r\uparrow$).

(4) Mercury is but one of the pollutants emitted by coal-burning sources. How do the authors try to achieve separation between mercury reduction benefits and the reduction of other pollutants?

Ans. See p. 312, where they argue that the mercury regulations are "not likely to have an impact on the overall level of particulate matter. The reason is that current regulations already impose caps on sulfur dioxides and nitrogen oxides, which are the primary pollutants that affect the level of particulate matter. Thus, mercury regulation is not likely to have any significant independent impact on the overall level of particulate matter, and is an expensive way to achieve them."

H. One of the two main methods for establishing the value of an environmental good is directly challenged by the Portney (1992 *J. Policy Anal. & Mgmt*), article on "Happyville." Which? In which direction does Portney's example bias the valuations? Give an environmental good or bad which might have the opposite bias, and explain what evidence there might be for this bias.

Ans. Survey methods that ask people for their values are dependent, for their relevance, to people understanding the risks. In Happyville, people are convinced that something, which is almost certainly harmless, is actually harmful. They therefore state a willingness to pay for its reduction that is far above its value.

For an example where people are not sufficiently concerned, consider endocrine disruptors (present in most modern plastics), or pesticides (for which much of the research into damaging effects is either not conducted or conducted under industry funding).