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

Due date: Wednesday, March 21, 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. de Groot, P. Sutton, S. Van der Ploeg, S. J. Anderson, I. Kubiszewski, S. Farber, and R. K. Turner. Changes in the global value of ecosystem services. *Global environmental change*, 26:152–158, 2014.

Demand for Environmental Goods

A. Kolstad, Ch. 7, problem 4.
B. Kolstad, Ch. 7, problem 5.

Hedonic Pricing

C. Kolstad, Ch. 8, problem 1.
D. Kolstad, Ch. 8, problem 2.
E. Kolstad, Ch. 8, problem 3.
F. Kolstad, Ch. 8, problem 6.

On the readings

G. These next questions refer to the Aizer *et al.* (2018 AEJ: Applied Econ) article about the effects of levels of blood lead and test scores.
   1. In lecture, we briefly talked about the "attenuation" effect that errors in variables has on regression coefficients. From your prob/stats class, the linear method to measure the relation, positive or negative, between random variables was their covariance. This has the drawback that it depends on the units of measurement, and one can see attenuation at work when we change to the unitless version of covariance called correlation.

      Correlation is one way to measure how related random variables, say X and Y, are. The advantage over covariance is that it is a unitless measure. Recall that

the covariance of X and Y is $\mathrm{Cov}(X,Y) = E\,(X-\mu_X)(Y-\mu_Y)$ where $\mu_X = E\,X$ and $\mu_Y = E\,Y$. The correlation of X and Y is defined as $\rho(X,Y) = \frac{\mathrm{Cov}(X,Y)}{\sigma_X \sigma_Y}$ where σ_X^2 is the variance of X and σ_Y^2 is the variance of Y.

   a. If one changes the scale of X (say from feet to meters), it is multiplied by a constant $\kappa > 0$. Compare $\mathrm{Cov}(X,Y)$ and $\mathrm{Cov}(\kappa X, Y)$.
   b. Compare $\rho(X,Y)$ and $\rho(\kappa X, Y)$.

2. Suppose that ε is a mean 0 measurement error for X and that ϵ is independent of X and Y.
   a. Compare $\mathrm{Cov}(X,Y)$ and $\mathrm{Cov}(X+\varepsilon, Y)$.
   b. Compare $\rho(X,Y)$ and $\rho(X+\varepsilon, Y)$.
   c. Show that as the variance of ε increases, the correlation $\rho(X+\epsilon, Y)$ decreases.
3. The reason that the previous results are important is that as correlation decreases, the measured strength of the linear relation between random variables decreases toward 0. What was the cause of the attenuation in this article? And why do the authors believe that it was an important effect, both statistically and economically?
4. The following is a short list of "confounders" that the authors control for: neighborhood effects; school effects; and grade effects. In each case, how might these lead to over-estimates of the damages?

H. 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?
2. The standard analysis of the efficiency of cap-and-trade programs points to the contemporaneous equalization of marginal costs of reduction across different sources. Unlike those analyses, the authors discuss flexibility not only across sources, but across time. Why might this provide additional savings to society? What are the margins being equalized in the authors' analysis?
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?
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? What might they have missed?

I. These questions refer to the article by Portney (1992 *J. Policy Anal. & Mgmt*), on "Happyville."
1. 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?

2. 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.
3. What is your answer to Portney's first question? Explain.
4. What is your answer to Portney's second question? Explain.

J. These next questions refer to the the Costanza *et al.* (1997, Nature) article. Be sure to review your introductory coverage of what GDP does and does not measure at some point.
1. The authors find that a lower bound to the value of the services that the ecosystem is currently providing to humans exceeds the world GDP by a large factor. How large? And why can this not represent a willingness-to-pay measure? If not willingness-to-pay, what is being measured?
2. Give three examples of why the authors believe that have presented and *under*-estimates of the value of the world's ecosystem and the damages currently being done to it.
3. The authors note that a main source of the increased values that they find are that the newer and more precise studies of the various biomes find higher values. Why might such a pattern exist?