# ECON4910 Environmental economics, Spring 2015

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**Lecture 9: Stock pollution**

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Please bring lecture notes to lecture.

*Reading:*

Perman et al. (2011). Chapter 16, in particular sections 16.4 and 16.1

Note: If you don’t have the book, you can find (almost) the same material in the 3rd edition, which is available at

<https://dutraeconomicus.files.wordpress.com/2014/01/roger-perman-yue-ma-michael-common-david-maddison-james-mcgilvray-natural-resource-and-environmental-economics-3rd-edition-2003.pdf>

You should have some knowledge of optimal control theory. The lecture note “Optimal control theory with applications for resource and environmental economics” gives you the necessary knowledge.

**Summary of main theory in Perman section 16.4**

1. Notation:
   * *M*  is a flow
   * *A* is a stock
   *  is rate of depreciation (Perman uses ). Two cases:
     1. 
     2. 
2. Stocks and flows; benefit of flow *B*(*M*) and cost/damage of stock *D*(*A*). Three case:
   1.  and  for all *A.*
   2.  and  for all *A.* I.e.  where *h* is a positive constant
   3.  for all *t* and  for , where .
3. The social optimum. Box 16.2 in Perman sec. 16.4
4. The optimal emission tax from equation (16.12) in Perman sec. 16.4 (which has a misprint ; should be = not +). Define . It follows from *Perman (16.12)* that



1. The steady-state equilibrium (for ). Perman Sec. 16.4.1.
2. More on the three possibilities of the *D*-function.

**Derivation of (\*) using optimal control theory (sketch; see the lecture note “Optimal control theory with applications for resource and environmental economics” for a more complete derivation):**

Max 

s.t.



Current value Hamiltonian



Optimal solution satisfies





Defining  this gives

 and the development of *q* is given by

 which implies that



where *K* is some constant. However, the transversality conditions imply that K=0, giving (\*)