Urban Economics: EC 3381

National University of Singapore, Spring 2012

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Problem Set 3

(To be discussed in Week 9 and 10)

Question 1. Exercise 3.2 in the textbook.

Question 2. Following the notation from class, suppose the average time cost function is

$$\begin{aligned} A(Q,X) &= 1, Q \leq X \\ &= 1 + \left(\frac{Q}{X} - 1\right)^2, Q > X, \end{aligned}$$

when highway capacity is X and there are Q drivers.

1. Suppose that $X = 1$, so that the average cost function simplifies to

$$A(Q) = 1 + (Q-1)^2.$$

Suppose that the (inverse) demand function for driving is $D(Q) = 8 - Q$.

(a) Derive the total driving cost function $T(Q)$ and the marginal cost function $M(Q)$.

(b) What is the equilibrium level of driving Q^e with no congestion tax? What is the average time cost at the equilibrium?

(c) What is the value of the externality term $A'(Q^e)Q^e$ at the equilibrium from (b)

(d) What is the socially optimal level of driving Q^* and what is the average time cost at the optimum?

(e) What congestion tax implements the socially optimal level of driving

(f) Graph your answer and illustrate the deadweight loss from the externality when there is no congestion tax.

(g) Suppose that the cost of capacity equals c per unit of capacity (in units of time). Suppose that the social planner picks Q and X to maximize total surplus and sets the socially optimal congestion tax. What would the cost of capacity c have to be if $X^* = 1$ were the solution to the social planner's problem?