ECON 110, Professor Hogendorn, Spring 2019

First Midterm Exam Section 2: Answers

1. *Instagram2_a.* The net value of liking posts on instagram is $u(i)$ minus the opportunity cost of time. To find the optimal number of likes, we take the ***first order condition,*** which is the derivative of net value set equal to 0. Another way to put this is that we will set ***marginal utility*** equal to ***marginal opportunity cost.***

   The marginal utility is the derivative

   $$MU(i) = \frac{du(i)}{di} = 3.625i^{-1/2}$$

   The cost of time is \$0.33 per minute, and it takes 3.8 minutes to produce 1 like, so the marginal opportunity cost of a like is $3.8 \times 0.33 = 1.254$.

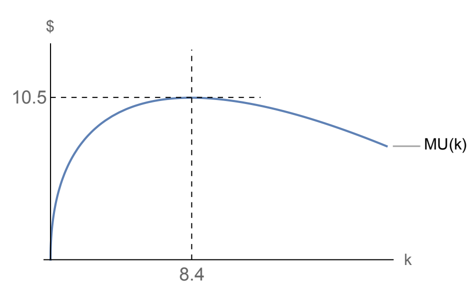
   The first order condition is then:

   $$MU(i) = MOC$$
   $$3.625i^{-1/2} = 1.254$$
   $$i^* = 8.4$$

   At this optimal number of likes, the net value is

   $$u(i^*) - 1.254i^* = 7.25 \times 8.4^{1/2} - 1.254 \times 8.4 = 21 - 10.50 = 10.50$$

   The maximization of net value can be graphed as a "hill:"

Note: Although the utility function is made up, the number of likes per day is real and the cost per minute is reasonable, so the net value should be somewhat realistic. Every year Instagram gets about \$7 billion in revenue from its 500 million users, so it gets about \$14 per user per year, or about \$0.38 per day. So pretty much no matter how you slice it, Instagram and its advertisers are only able to get a tiny fraction of the value it generates. Food for thought.

2. *Jets2_a.*

   (a) The first and second derivatives are

   $$\frac{dQ_d}{dP} = -1.8\times 500P^{-2.8} < 0 \qquad \frac{d^2Q_d}{dP^2} = (-2.8)(-1.8)500P^{-3.8} > 0$$

   The first derivative is negative (for any value of P), thus the function must slope down. The second derivative is positive, thus the slope must be getting less steep as price increases. The graph looks like in part (c).

   (b) It *is* somewhat surprising. Jet fuel is a ***complement*** to aircraft, and the fall in price of a complement will increase demand. But these particular aircraft were designed with fuel efficiency in mind. They are ***substitutes*** for other fuel-guzzling aircraft. The decline in jet fuel price makes those other aircraft more attractive, and reduces demand for the fuel-efficient segment. So for the given Q'_d, it looks like the complement effect was more powerful than the substitute effect.

   Contrary to what it says in this problem, the real life dominant effect has been to reduce demand in this segment.

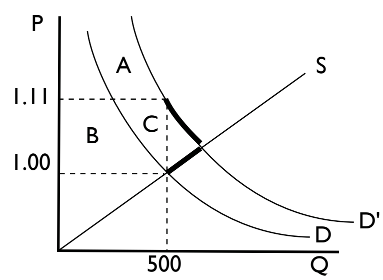
   (c) The original supply-demand equilibrium is

   $$\begin{aligned} 500P^{-1.8} &= 500P \\ 1 &= P^2.8 \\ P = 1 & \qquad Q = 500 \end{aligned}$$

The quantity 500 is lower than the equilibrium that would occur with the new demand curve. We expect that the shortage of aircraft will cause the price to be bid up and that demand will be the ***governing curve.*** The price will rise so that

$$600P^{-1.8} = 500$$
$$P^{-1.8} = 0.83$$
$$P' = (0.83)^{-\frac{1}{1.8}} = 1.11$$

Producer surplus rises by $(1.11 - 1)500 = 55$. Consumer surplus falls because of the higher price but rises because of the curve shift. On a graph, the change in producer surplus $+B + C$ and the change in consumer surplus is $+A - B$.



Finding the exact amount of the change in consumer surplus is tricky because the curve are nonlinear. Triangular approximations are totally acceptable. But for the record, the exact amount is

$$\int_{1.11}^{\infty} 600P^{-1.8} - \int_{1}^{\infty} 500P^{-1.8} =$$
$$-750p^{0.8}\Big|_{1.11}^{\infty} - (-625)p^{0.8}\Big|_{1}^{\infty} =$$
$$689.9 - 625 = 64.9$$

(d) The curve segments with the thick lines represent the MPB (top) and MPC (bottom) of airplanes betweeb the controlled quantity and what would be the new equilibrium quantity.

Marginal private benefits to consumers (the airlines) include most importantly the profits from transporting passengers. To the extent that travelers' benefits from traveling are reflected in airline ticket prices, they are included in marginal private benefits too. Marginal private costs of producers (Airbus and Boeing) include labor costs and airplane parts.

When airplanes are consumed (used) by airlines, they create pollution, so there is a negative externality in consumption. If there are technology spillovers from learning and sharing knowledge in the aircraft industry, then there would be a positive externality in the production of airplanes.