ECON 110, Professor Hogendorn, Spring 2019

First Midterm Exam Section 3: Answers

1. 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:

   $$\begin{aligned} MU(i) &= MOC \\ 3.625i^{-1/2} &= 1.254 \\ i^* &= 8.4 \end{aligned}$$

   At this optimal number of likes, the net value is

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

   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. *Jets.* Two large jets, the A350-1000 and the Boeing 777X are designed to replace older, less fuel-efficient aircraft. Currently there are 500 orders for these jets. The demand function for this segment of the aircraft market is $Q_d = 500P^{-1.8}$.

   (a) Substituting into the elasticity formula gives

$$\begin{aligned} E_d &= \frac{dQ_d}{dP}\frac{P}{Q_d} \\ &= -1.8 \times 500P^{-2.8}\frac{P}{500P^{-1.8}} \\ &= -1.8 \times \frac{P^{1.8}P}{P^{2.8}} \\ &= -1.8 \end{aligned}$$

   So this is a ***constant elasticity demand curve,*** and the elasticity is the same at every price.

   (b) There are two effects. The first is that jet fuel is a ***complement*** to aircraft, and the fall in price of a complement will increase demand. This argues for the curve $Q_d = 600P^{-1.8}$ which is an outward shift of the demand curve.

   The other effect is that 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. This argues for an inward shift of the demand curve to $Q_d = 400P^{-1.8}$.

   In real life, the dominant effect has been to reduce demand in this segment.

   (c) The original supply-demand equilibrium is

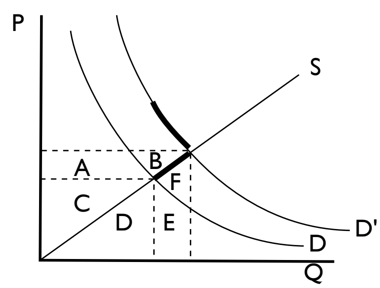
$$\begin{aligned} 500P^{-1.8} &= 500P \\ 1 &= P^2.8 \\ P = 1 &\qquad Q = 500 \end{aligned}$$

If you use the demand curve $Q_d = 600P^{-1.8}$, the new equilibrium price and quantity are

$$\begin{aligned} 600P^{-1.8} &= 500P \\ 1.2 &= P^{2.8} \\ P' = 1.07 & \qquad Q' = 533.6 \end{aligned}$$

Spending rises from $PQ = 1 \times 500 = 500$ to $P'Q' = 1.07 \times 533.6 = 571$. Because the supply curve goes through the origin, spending is equally divided between producer surplus and variable costs, so both go up by $\frac{571-500}{2} = 35.5$.

On a graph, the change in producer surplus is from C to $A + B + C$ and the change in variable costs is from D to $D + E + F$.



(d) The curve segments with the thick lines represent the MPB (top) and MPC (bottom) of the changed number of airplanes. 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.