

Handout 5: Consumers, Producers, and the Efficiency of Markets

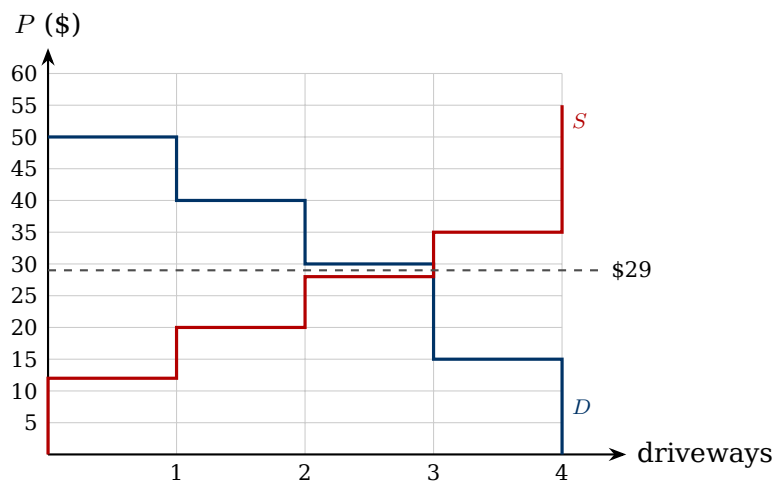
Mankiw Ch 7

Answer key

Problem 1. Shoveling driveways

After a snowstorm, four households want their driveway shoveled and four students are willing to shovel one driveway each. Each household's willingness to pay and each student's cost (the value of the time and effort) are:

Household	Willingness to pay	Student	Cost
Ortiz	\$50	Sam	\$12
Park	\$40	Tia	\$20
Quinn	\$30	Uma	\$28
Reyes	\$15	Vic	\$35



- a) Draw the demand curve and the supply curve on the grid.

Demand is a staircase down from \$50 (1 driveway), \$40 (2), \$30 (3), \$15 (4). Supply is a staircase up from \$12 (1), \$20 (2), \$28 (3), \$35 (4). See the figure.

- b) In a competitive market, how many driveways are shoveled? What range of prices clears the market? Which household and which student do not trade?

Pair the highest values with the lowest costs while value $\geq$ cost: Ortiz-Sam (50 vs 12), Park-Tia (40 vs 20), Quinn-Uma (30 vs 28). Reyes (15) and Vic (35) would not: **3 driveways**.

Any price from **\$28 to \$30** clears the market: at those prices Uma shovels and Vic does not, Quinn buys and Reyes does not.

Reyes and **Vic** do not trade: Reyes values the job below every price at which Vic would do it.

- c) Suppose the price is \$29. Find each household's consumer surplus, each student's producer surplus, and total surplus.

CS: Ortiz $50 - 29 = 21$, Park 11, Quinn 1; total **CS = \$33**.

PS: Sam $29 - 12 = 17$, Tia 9, Uma 1; total **PS = \$27**.

Total surplus = \$60, which is also $(50 + 40 + 30) - (12 + 20 + 28) = 120 - 60$. Any price from \$28 to \$30 gives the same total; the price only splits it.

- d) The town caps the price of shoveling at \$25. How many driveways are shoveled now? Is there a shortage? If the jobs go to the households who value them most, what is total surplus, and what is the **deadweight loss**? What if the jobs go to Park and Quinn instead?

At \$25 only Sam (12) and Tia (20) will shovel: **2 driveways**. Ortiz, Park and Quinn all want one at \$25 (Reyes does not): a **shortage of 1**.

Jobs to Ortiz and Park: $TS = (50 + 40) - (12 + 20) = \$58$. Deadweight loss $= 60 - 58 = \$2$: Quinn and Uma's trade (30 vs 28) no longer happens.

Jobs to Park and Quinn: $TS = (40 + 30) - 32 = \$38$, a loss of \$22. The cap loses the \$2 trade, and the rationing gives a job to Quinn (30) instead of Ortiz (50), which costs another \$20.

- e) The town instead pays to have every driveway shoveled, so all four households get one and all four students work. What is total surplus? Why is it lower than in (c)?

$TS = (50 + 40 + 30 + 15) - (12 + 20 + 28 + 35) = 135 - 95 = \$40$, \$20 less than the market's \$60.

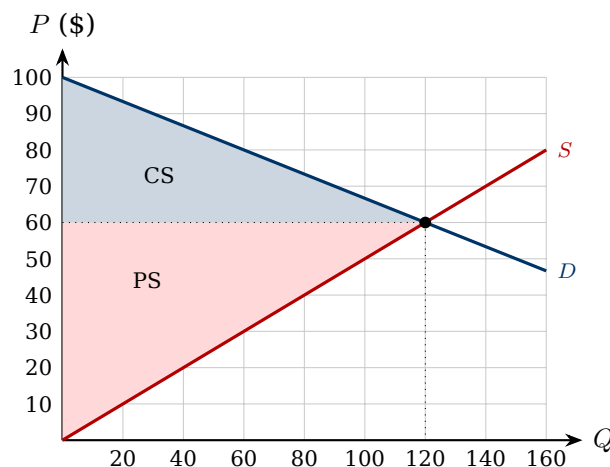
The fourth job is worth \$15 to Reyes and costs Vic \$35 of effort: producing it destroys \$20 of surplus. Too much is a deadweight loss just as too little is.

Problem 2. Kayak rentals

The daily market for kayak rentals on the Charles River is described by

$$Q_d = 300 - 3P \quad Q_s = 2P$$

where P is the price of a rental in dollars and Q is rentals per day.



- a) Find the equilibrium price and quantity.

$$300 - 3P = 2P, \text{ so } P^* = \mathbf{\$60} \text{ and } Q^* = \mathbf{120} \text{ rentals.}$$

- b) Draw both curves on the grid. Shade consumer surplus and producer surplus, and compute each and total surplus.

$$\text{Demand reaches } Q = 0 \text{ at } P = 100. \text{ CS} = \frac{1}{2} \times 120 \times (100 - 60) = \mathbf{\$2,400}. \text{ PS} = \frac{1}{2} \times 120 \times 60 = \mathbf{\$3,600}. \mathbf{TS = \$6,000}.$$

- c) What is the 60th rental worth to the person who rents it, and what does it cost the owner to provide? Explain why it should be rented.

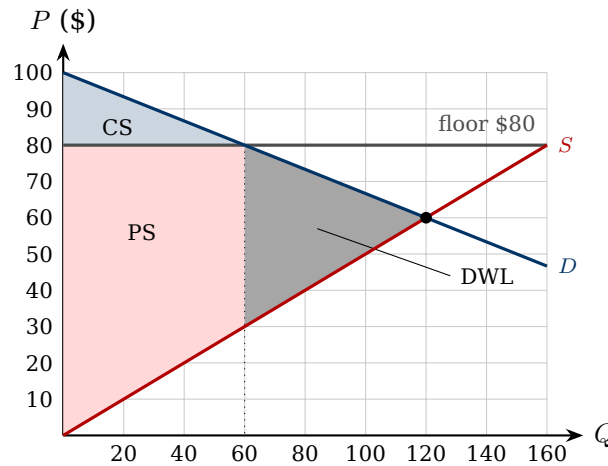
$$\text{From } P = 100 - Q/3: \text{ the 60th rental is worth } \mathbf{\$80}. \text{ From } P = Q/2: \text{ it costs } \mathbf{\$30}. \text{ Renting it adds } 80 - 30 = \$50 \text{ to total surplus, so leaving it unrented would lose } \$50.$$

- d) A sunny summer raises demand to $Q_d = 350 - 3P$. Find the new price and quantity. By how much does producer surplus rise? Split the gain between owners who were already renting and new rentals.

$$350 - 3P = 2P: P = \mathbf{\$70}, Q = \mathbf{140}. \text{ PS} = \frac{1}{2} \times 140 \times 70 = \$4,900, \text{ up } \mathbf{\$1,300}. \text{ Existing rentals: 120 rentals, \$10 more each} = \$1,200. \text{ New rentals: 20 more, each costing between \$60 and \$70: } \frac{1}{2} \times 20 \times 10 = \$100.$$

- e) Back to the original demand. The kayak owners persuade the city to set a price floor of \$80. How many kayaks are rented? Find CS, PS (assume the rentals go to the owners with the lowest cost), total surplus and the deadweight loss. Who gains and who loses?

$$\begin{aligned} \text{At } \$80: Q_d &= 300 - 240 = 60 \text{ and } Q_s = 160, \text{ a surplus of 100. Only } \mathbf{60} \text{ kayaks are rented.} \\ \text{CS} &= \frac{1}{2} \times 60 \times (100 - 80) = \mathbf{\$600}. \\ \text{PS: the 60 lowest-cost owners (cost \$0 to \$30) get \$80: } &60 \times (80 - 30) + \frac{1}{2} \times 60 \times 30 = 3,000 + 900 = \mathbf{\$3,900}. \\ \text{TS} &= \$4,500. \mathbf{Deadweight loss = \$1,500} = \frac{1}{2} \times (120 - 60) \times (80 - 30): \text{ the 60 rentals between } Q = 60 \text{ and } Q = 120, \text{ each worth more than it costs, no longer happen.} \\ \text{Renters lose } &\$1,800. \text{ Owners gain } \$300, \text{ and only if the rentals go to the lowest-cost owners; if they go to owners chosen any other way, PS is lower and the owners can lose too.} \end{aligned}$$

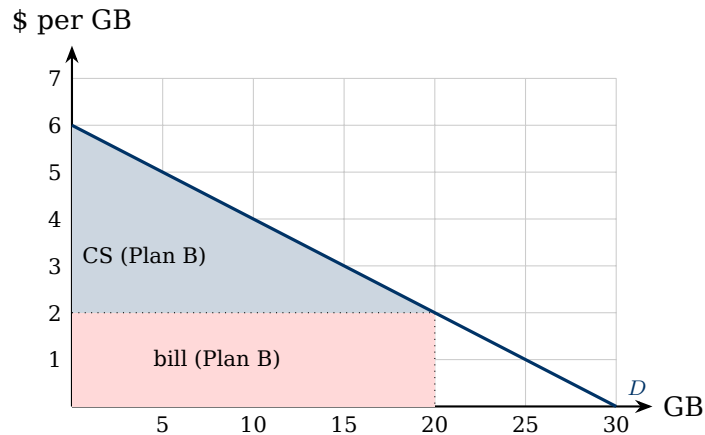


Problem 3. Choosing a data plan

Maya's monthly demand for mobile data is

$$Q = 30 - 5P$$

where Q is gigabytes (GB) a month and P is the price she pays for one more GB.



- a) **Plan A:** unlimited data for \$60 a month. What does one more GB cost her? How many GB does she use? What is the data worth to her in total, and what is her consumer surplus?

One more GB costs her **\$0**, so she uses data until it is worth nothing to her:
 $Q = 30 - 0 = \mathbf{30}$ GB.
 Total value = the whole area under her demand curve = $\frac{1}{2} \times 30 \times 6 = \$90$. CS
 = $90 - 60 = \mathbf{\$30}$.

- b) **Plan B:** \$2 per GB, no monthly fee. How many GB does she use? What is her bill, the total value of her data, and her consumer surplus?

$Q = 30 - 10 = \mathbf{20}$ GB. Bill = $2 \times 20 = \$40$.

Value = area under demand from 0 to 20 GB = the bill rectangle plus the triangle above it = $40 + \frac{1}{2} \times 20 \times (6 - 2) = 40 + 40 = \$80$. CS = $80 - 40 = \mathbf{\$40}$.

- c) Which plan should she choose? She uses more data on Plan A; why is it still the worse deal?

Plan B: \$40 of CS against \$30. Plan A's extra 10 GB are worth only $\frac{1}{2} \times 10 \times 2 = \$10$ to her, and she pays \$20 more for the plan (60 - 40). The last GBs she uses on Plan A are worth almost nothing to her.

- d) At what monthly price would Plan A be exactly as good for her as Plan B?

Plan A is worth \$90 to her; she needs CS of \$40: $90 - F = 40$, so $F = \mathbf{\$50}$.

- e) Plan B cuts its price to \$1 per GB. How many GB does she use, and what is her consumer surplus? How much of the gain comes from GBs she already used, and how much from new ones?

$Q = 30 - 5 = \mathbf{25}$ GB. CS = $\frac{1}{2} \times 25 \times (6 - 1) = \mathbf{\$62.50}$, up \$22.50.

The 20 GB she already used now cost \$1 less each: \$20. The 5 new GB are worth between \$1 and \$2 each and cost \$1: $\frac{1}{2} \times 5 \times 1 = \$2.50$.

Problem 4. Efficient or not?

Answer each in two or three sentences.

- a) The Celtics sell 200 playoff tickets by lottery at \$50 each and ban resale. Is this allocation efficient? What happens to total surplus if resale is allowed?

Not efficient. A lottery gives some tickets to fans who value them at, say, \$60, while fans who would pay \$500 go without. With resale, a winner who values the ticket below what another fan will pay sells it; both gain, so **total surplus rises** and the tickets end up with the fans who value them most. The winners keep the gain from the lottery, as cash instead of a seat.

- b) "A scalper who buys a ticket for \$100 and sells it for \$300 makes society worse off." True or false?

False by the measure of total surplus. The fan who pays \$300 values the ticket at least \$300, more than whoever would have used it at \$100; the ticket moves to a higher-value use. The \$200 markup moves surplus from the buyer to the scalper; it is not lost. Whether that split is fair is a question of equality, not efficiency.

- c) A cement plant sells in a competitive market, and its kilns pollute the air of the town around it. Is the market quantity of cement efficient?

No. The supply curve reflects the plant's costs but not the cost of the pollution to the town, so the true cost of each bag is above the supply curve. At the market quantity the last bags cost society more than they are worth to buyers: the market produces **too much**. This is an externality, a market failure (Ch 10).

- d) "The market equilibrium maximizes total surplus, so the market outcome is fair." True or false?

False. Efficiency is about the size of the pie; fairness is about how it is divided. A market gives goods to those willing to pay the most, and willingness to pay depends on income: a rich buyer's \$500 can beat a poor buyer's greater need. The market can be efficient and still leave an outcome many people judge unfair.