

ECON 201 – Problem Set 1

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- Q1. Two consumers and two goods.** Suppose there are only two goods (X and Y) and only two individuals (numbered 1 and 2) in an economy. Let P_X be the price of good X and P_Y be the price of good Y. Let I_1 represent the income of individual 1 and I_2 the income of individual 2. Suppose the quantity of good X demanded by individual 1 is given by

$$X_1 = 10 - 2P_X + 0.01I_1 + 0.4P_Y,$$

and the quantity of X demanded by individual 2 is

$$X_2 = 5 - P_X + 0.02I_2 + 0.2P_Y.$$

(a) Graph the two individual demand curves (with X on the horizontal axis and P_X on the vertical axis) for the case $I_1 = 1000$, $I_2 = 1000$, and $P_Y = 10$.

(b) Using the individual demand curves obtained in part (a), graph the market demand curve for total X . What is the algebraic equation for this curve?

- Q2. Market demand from inverse demands.** There are four individuals, Alice, Bob, Chris and Dale who buy widgets. Their individual inverse demands are:

$$P(x_A) = 5 - x_A,$$

$$P(x_B) = 10 - 5x_B,$$

$$P(x_C) = 20 - x_C,$$

$$P(x_D) = 10 - 2x_D.$$

(a) Derive an expression for the market demand for widgets. Graph this market demand with price on the vertical axis and widgets on the horizontal axis.

(b) Along which segment of the market demand curve is demand most elastic? Along which segment is demand most inelastic?

(c) Suppose the market supply of widgets at a given price is $S(P) = -6 + \frac{3}{2}P$. What is the equilibrium price and quantity? Which consumers are buying positive amounts of the good?

(d) Is it possible for the market demand curve (sum of linear individual demands) to get *steeper* as we move to the right? Why or why not?

- Q3. Elasticity functional forms.** Consider the demand function $Q = \beta P^\alpha$.

(a) Find the conditions on α and β for which the demand curve makes sense, i.e. Q is decreasing in P .

(b) Find the price elasticity of demand. Does it depend on Q or P ? Explain.

(c) Now consider $Q = \gamma P^\alpha I^\beta$ where I denotes income. Find the conditions on γ, α, β such that demand is decreasing in price and increasing in income.

(d) Find the price and income elasticities of demand for this demand function.

- Q4. Elasticity on a linear demand.** Consider $Q = \beta P^\alpha$ [or use $Q = 500 - 10P$ as a numerical example]. Compute the point price elasticity at different prices; classify elastic/inelastic/unit-elastic and interpret how elasticity varies along a linear demand.
- Q5. Cigarette tax with different demand elasticities.** Elasticity of demand (General Public): -0.45 ; Elasticity of demand (Teenagers): -0.7 ; Elasticity of supply: 7.0 ; Current price: $\$5.51$; Current sales: $17.4B$.
- Estimate supply and demand functions.
 - Solve for the equilibrium price and quantity.
 - Add a $\$1$ per-pack tax: find the new equilibrium; compute percentage fall in sales.
 - Given the price increase, by what percentage should teenage smoking fall?
- Q6. Coffee market taxes.** Demand and supply are $Q_D = 100 - P$, $Q_S = 20 + 3P$. For each case, find the buyer and seller prices in equilibrium, tax burdens, tax revenue, changes in CS and PS, and DWL.
- Unit tax of $\$16$ on the supplier.
 - Unit tax of $\$16$ on the buyer.
 - Proportional (ad valorem) tax of 10% on the supplier.
 - Proportional (ad valorem) tax of 10% on the buyer.
- Q7. Quota on a cleaning product.** $Q_D = 1000 - 2P$, $Q_S = 100 + P$.
- Find the free-market equilibrium.
 - Impose a quota $Q \leq 300$. Find the resulting equilibrium price(s) and quantities; illustrate on a graph and compute the numerical changes.
- Q8. True/False on elasticity (from PS1).** Answer and briefly explain:
- If price elasticity of demand is 0.8 , an increase in price raises total spending.
 - If a 10% price increase raises revenue by 10% , demand is unit elastic.
 - Drug interdiction (reducing supply) is less effective than demand education because interdiction lowers drug prices.
 - Normal goods have negative income elasticities; inferior goods have positive income elasticities.
 - Steepness/flatness of a demand curve is about absolute changes; elasticity is about percentage changes.
- Q9. Tax incidence in elasticities (derivation).** A per-unit tax t is imposed in a competitive market. Let ε_D and ε_S denote the demand and supply elasticities (evaluated at the pre-tax equilibrium). Derive the pass-through formulas for the change in the buyer price ΔP_b and seller price ΔP_s in terms of $t, \varepsilon_D, \varepsilon_S$. (Hint: Totally differentiate $Q_D(P_b) = Q_S(P_s)$ with $P_b = P_s + t$ and express $D'(P_b), S'(P_s)$ using elasticities.)
- Q10. Excise tax equivalence (UW–Madison).** In a competitive market with linear demand and supply, an excise tax of amount t is (i) levied on producers and (ii) levied on consumers. For each case, set up the post-tax equilibrium conditions, solve for buyer price P_b , seller price P_s , and quantity Q , and show that *economic incidence* (who bears the burden) does not depend on who remits the tax. (Adapted from UW–Madison Econ 101 homework solutions.)
- Q11. MIT OCW – Shifts in supply and demand (cross-price effects).**
In the market for apple juice, suppose supply is $Q_S = 10P_J - 5P_A$ and demand is $Q_D = 100 - 15P_J + 10P_T$, where P_A is the price of apples and P_T is the price of tea. Assume $P_A = 1$ and $P_T = 5$.

- (a) Find the equilibrium price P_J and quantity Q .
- (b) Suppose P_A increases. Show how the supply curve shifts and compute new equilibrium.
- (c) Suppose P_T increases. How does the demand curve shift and what is the new equilibrium?
- (d) Interpret how the prices of related goods feed into supply/demand interactions.

Q12. MIT OCW – Quota and demand shift.

For bottled water, demand shifts right after a heat wave. The city imposes a quota of $Q = 100$.

- (a) Draw the initial equilibrium.
- (b) Show the effect of the demand shift and compute new price and quantity (without quota).
- (c) Apply the quota: find resulting price and quantity, show over/under supply, and quota rent area.
- (d) Compare welfare difference between quota and no quota.

Q13. Syracuse – Price floor (milk market).

Demand: $P = 12 - 0.5Q_D$, Supply: $P = 0.1Q_S$.

- (a) Find equilibrium price and quantity.
- (b) Suppose price floor at $P = 2.50$. What is new quantity sold?
- (c) Compute changes in CS and PS.
- (d) If government purchases excess supply, how much must it buy?
- (e) Show all areas on a graph.

Q14. Nonlinear demand with tax (bicycles).

Demand: $Q_D = 500 - 5P$, Supply: $Q_S = 20P$.

- (a) Find equilibrium price and quantity.
- (b) Impose per-unit tax $t = 5$. Find new prices and quantity.
- (c) Compute changes in CS, PS, tax revenue, DWL.
- (d) Repeat for $Q_D = 1000 - 10P^2$ and compare.

Q15. Subsidy vs. tax comparison (Chicago).

Demand: $Q_D = 300 - 3P$, Supply: $Q_S = -50 + 2P$.

- (a) Find equilibrium without intervention.
- (b) Introduce subsidy $s = 10$. Find new equilibrium and incidence.
- (c) Compute CS, PS, government cost, DWL.
- (d) Replace subsidy with tax $t = 10$. Compute new equilibrium and welfare.
- (e) Compare welfare effects of subsidy vs tax.