Intermediate Microeconomics. Lecture 10

Extra Material: Weeks 1 and 2

Oscar Gálvez-Soriano[1]

[1]University of Houston
Department of Economics

Summer 2021

Contents

Q1. Supply and Demand

Suppose a market is represented by the following supply and demand equations

$$Q^D = 20,000 - 1,000 * P$$

$$Q^S = -12,000 + 3,000 * P$$

- What is the equilibrium price?

To find the equilibrium price we set quantity supplied equal to quantity demanded and solve for P.

$$Q^D = Q^S$$

Q1. Supply and Demand

$$Q^D = Q^S$$

$$20,000 - 1,000 * P = -12,000 + 3,000 * P$$

$$4,000 * P = 32,000 \;\Rightarrow\; \boxed{P^* = 8}$$

- What is the equilibrium quantity?

Plug P^* into either the supply or demand equation

$$Q = 20,000 - 1,000 * (8) \;\Rightarrow\; \boxed{Q^* = 12,000}$$

Q1. Supply and Demand

- What is consumer surplus?

First find the demand choke price

$$Q^D = 20,000 - 1,000 * P$$

$$0 = 20,000 - 1,000 * P \;\Rightarrow\; P = 20$$

The consumer surplus is the area of the triangle above the equilibrium price

$$CS = (\frac{1}{2}) * (12,000) * (20 - 8) = 12,000 * 6 \;\Rightarrow\; \boxed{CS = 72,000}$$

Q1. Supply and Demand

- What is producer surplus?

First find the supply choke price

$$Q^S = -12,000 + 3,000 * P$$

$$0 = -12,000 + 3,000 * P \;\Rightarrow\; P = 4$$

The producer surplus is the area of the triangle below the equilibrium price

$$PS = (\frac{1}{2}) * (12,000) * (8-4) = 12,000 * 2 \;\Rightarrow\; \boxed{PS = 24,000}$$

Q1. Supply and Demand

- What is the total surplus received by both producers and consumers?

$$TS = CS + PS = 72,000 + 24,000 \Rightarrow \boxed{TS = 96,000}$$

Q2. Supply and Demand

Suppose a market for beer is represented by the following supply and demand equations

$$Q^D = 6,000 - 1,500 * P$$

$$Q^S = -1,000 + 2,000 * P$$

German government sets a price ceiling of one Pfennig

- Accurately graph the demand curve, supply curve, and the price ceiling

Q2. Supply and Demand

Remember that to graph the demand and supply curves we need to re-express the demand and supply equations as their inverse equations.

$$Q^D = 6,000 - 1,500P \;\Rightarrow\; P = 4 - \frac{1}{1,500}Q^D$$

$$Q^S = -1,000 + 2,000P \;\Rightarrow\; P = 0.5 + \frac{1}{2,000}Q^S$$

Price ceiling is simply a horizontal line at the price level (in our example at one)

Q2. Supply and Demand

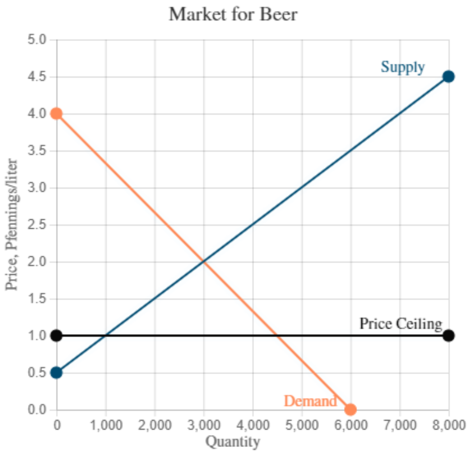

Figure: Supply and Demand with Price Ceiling

Q2. Supply and Demand

- Calculate equilibrium price, equilibrium quantity, consumer surplus, and producer surplus at the equilibrium
- With the price ceiling of 1-Pfennig. What is the producer surplus received by beer producers after the price ceiling is imposed? What is consumer surplus after the price ceiling?

Producer surplus is the area of the triangle below price ceiling and above the supply curve

$$PS = (\frac{1}{2}) * (1,000) * (1 - 0.5) = 1,000 * \frac{1}{4} \Rightarrow \boxed{PS = 250}$$

Q2. Supply and Demand

Now, consumer surplus is a more interesting case

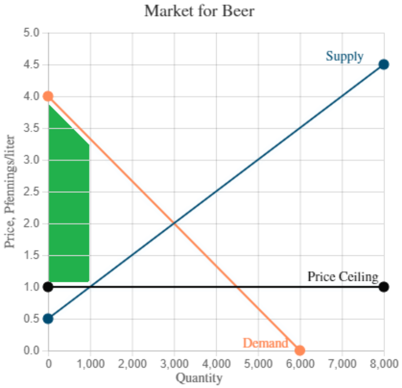

Figure: Consumer Surplus with Price Ceiling

Q2. Supply and Demand

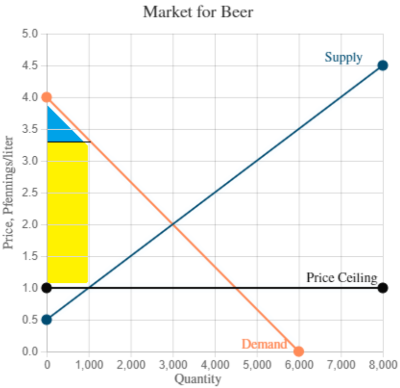

Figure: Consumer Surplus with Price Ceiling

$$Q^D = 6,000 - 1,500P = 1,000 \Rightarrow P = \frac{5,000}{1,500} \Rightarrow P \approx 3.3333$$

Q2. Supply and Demand

$$Area(triangle) = (\frac{1}{2}) * (1,000) * (4 - 3.3333) \approx 333.3333$$

$$Area(rectangle) = (1,000) * (3.3333 - 1) \approx 2,333.3333$$

$$CS = Area(triangle) + Area(rectangle) \approx 333.3333 + 2,333.3333$$

$$\boxed{CS \approx 2666.6667}$$

Q3. Elasticities and taxes

Suppose the following are the demand ans supply equation in the market of ice cream

$$Q^D = 20 - 2P$$

$$Q^S = 4P - 10$$

- Plot the supply and demand curves

$$Q^D = 20 - 2P \;\Rightarrow\; P = 10 - \frac{1}{2}Q^D$$

$$Q^S = 4P - 10 \;\Rightarrow\; P = 2.5 + \frac{1}{4}Q^S$$

Q3. Elasticities and taxes

- When comparing the supply and demand curve, which is more inelastic? **Demand**

$$E = \frac{\Delta Q}{\Delta P} \cdot \frac{P}{Q} = \frac{1}{slope} \cdot \frac{P}{Q}$$

$$E^D = -2 \cdot \frac{P}{Q}$$

$$E^S = 4 \cdot \frac{P}{Q}$$

Q3. Elasticities and taxes

- With a \$1 tax per gallon of ice cream, who will bear the greater tax burden? **Buyers will bear the greater burden because demand is more inelastic than supply**

Contents

Q1. Consumer Behavior

Carmen is a writer who enjoys writing with both pencils and pens. Her utility function for pencils and pens is given by

$$U = 4X + 2Y$$

where X is the number of pencils she buys and Y is the number of pens. Carmen currently has 2 pencils and 4 pens

- Calculate Carmen's current utility: $U = 16$

Q1. Consumer Behavior

- What is the marginal utility of an additional pencil, MU_X? An additional pen, MU_Y?

$$MU_X = \frac{\partial U(X,Y)}{\partial X} \Rightarrow \boxed{MU_X = 4}$$

$$MU_Y = \frac{\partial U(X,Y)}{\partial Y} \Rightarrow \boxed{MU_Y = 2}$$

- Calculate the MRS at Carmen's current consumption level

$$MRS_{XY} = \frac{MU_X}{MU_Y} = \frac{4}{2} \Rightarrow \boxed{MRS_{XY} = 2}$$

Q2. Consumer Behavior

Jose gets satisfaction from both music and fireworks. Jose's income is \$240 per week. Jose can buy a song on iTunes for \$1, and fireworks cost \$8 per bag

- Plot in a graph Jose's budget constraint
- What is the slope of the budget constraint? **-8**

$$I = P_X X + P_Y Y \;\Rightarrow\; 240 = X + 8Y \;\Rightarrow\; \boxed{X = 240 - 8Y}$$

Q2. Consumer Behavior

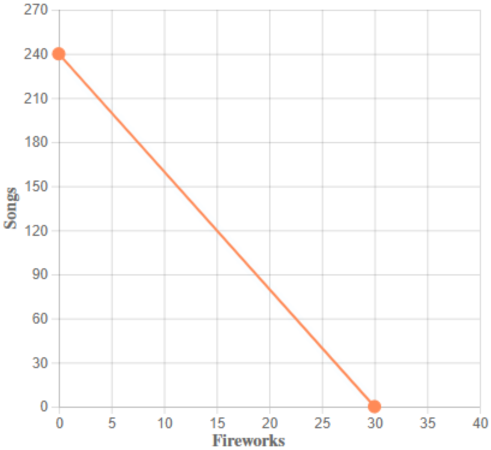

Figure: Budget constraint

Q2. Consumer Behavior

- Suppose that a holiday bonus raises Jose's income temporarily to \$360. Draw Jose's new budget constraint

$$I = P_X X + P_Y Y \Rightarrow 360 = X + 8Y \Rightarrow \boxed{X = 360 - 8Y}$$

Q2. Consumer Behavior

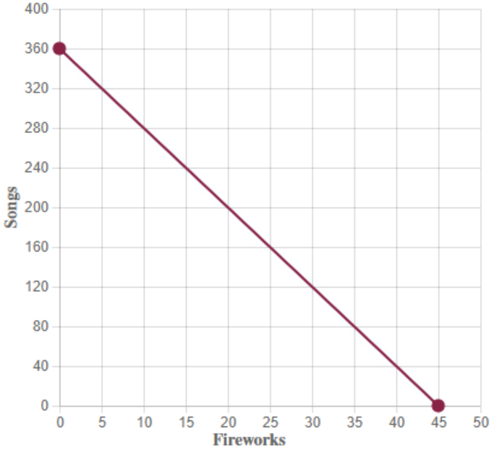

Figure: Budget constraint

Q3. Consumer Behavior

John enjoys pizza and renting movies online. He makes \$30 each week at a part-time job. For each of the following scenarios, graph John's budget constraint. Assume that each scenario happens in isolation

- Illustrate John's budget constraint in the space below if a movie rental is \$2 and a pizza costs \$7.50

$$I = P_X X + P_Y Y \;\Rightarrow\; 30 = 2X + \frac{15}{2}Y \;\Rightarrow\; \boxed{X = 15 - \frac{15}{4}Y}$$

Q3. Consumer Behavior

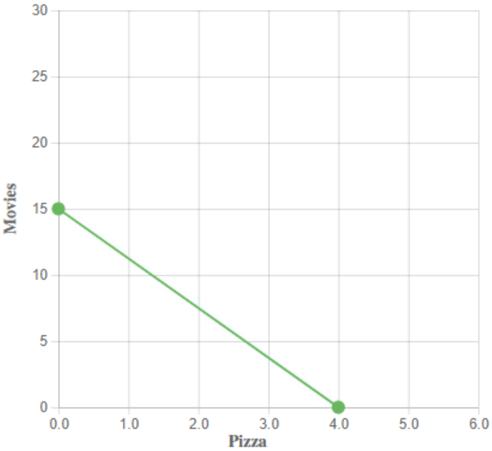

Figure: Budget constraint

Q3. Consumer Behavior

- Suppose John's mother finds a coupon for one free pizza and gives it to him

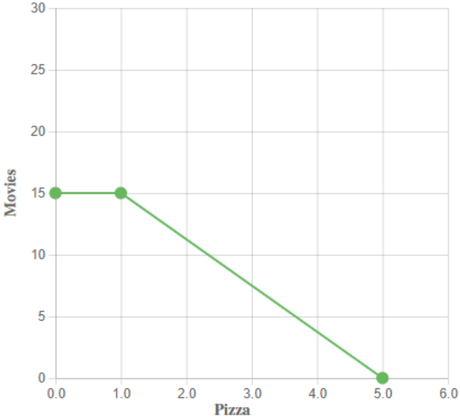

Figure: Budget constraint

Q3. Consumer Behavior

- Now suppose the movie rental site sponsors a holiday promotion: rent 5 movies at full price and receive a 50 percent discount on all additional rentals

For the first 5 movies we have the same BC

$$\boxed{X = 15 - \frac{15}{4}Y \ \ if \ \ X \leq 5}$$

But for more than 5 movies the new movie price is \$1 and the new income is \$25 (why?), so the new BC is

$$25 = X + \frac{15}{2}Y \ \Rightarrow \boxed{X = 25 - \frac{15}{2}Y \ \ if \ \ X \geq 5}$$

Q3. Consumer Behavior

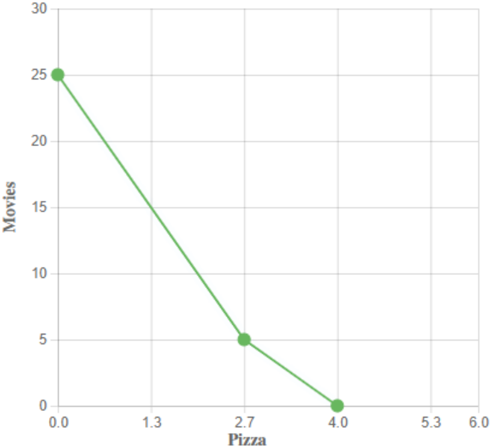

Figure: Budget constraint

Q3. Consumer Behavior

- The price of pizza increases from \$7.50 to \$10

$$I = P_X X + P_Y Y \;\Rightarrow\; 30 = 2X + 10Y \;\Rightarrow\; \boxed{X = 15 - 5Y}$$

Q3. Consumer Behavior

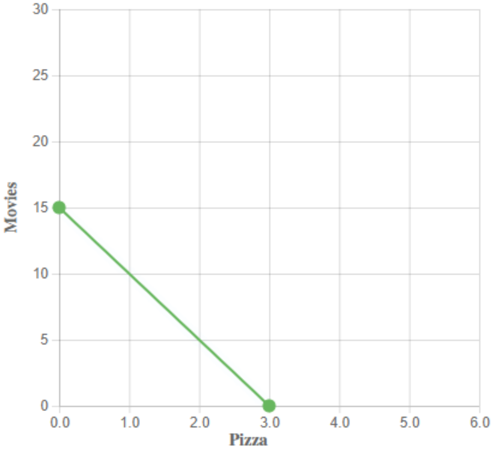

Figure: Budget constraint

Q4. Consumer Behavior

For Maahir, shampoo (S) and conditioner (C) are perfect complements. He uses 1 pump of shampoo and 1 pump of conditioner every time he washes his hair.

- Assume that shampoo costs \$0.40 per pump and conditioner costs \$0.20 per pump. If Maahir's budget for shampoo and conditioner is \$12, write the equation for his budget constraint

$$I = P_S S + P_C C \;\Rightarrow\; \boxed{12 = 0.4S + 0.2C}$$

Q4. Consumer Behavior

- What is Maahir's optimal bundle of shampoo and conditioner?

We know that this consumer is purchasing the same amount of shampoo and conditioner, no matter what the prices are

$$S = C = X$$

Then we have to satisfy the budget constraint

$$12 = 0.4X + 0.2X \ \Rightarrow \ 12 = 0.6X \ \Rightarrow \ 12 = \frac{6}{10}X$$

$$\boxed{X = C = S = 20}$$

Contents

Q1. Individual and Market Demand

Mitch utility function is given as follows

$$U(x_1, x_2) = x_1 + 5x_2$$

where x_1 represents pencils and x_2 represents pens

- Plot the indifference curve

$$\bar{U} = 5x_1 + x_2 \;\Rightarrow\; x_2 = \bar{U} - 5x_1$$

Q1. Individual and Market Demand

- Suppose Mitch has \$10 to spend on pens and pencils and that pens and pencils each cost \$1. Using these prices and income, plot Mitch's budget line

$$I = P_1 x_1 + P_2 x_2 \;\Rightarrow\; 10 = x_1 + x_2$$

$$\boxed{x_2 = 10 - x_2}$$

- Next, plot Mitch's budget line assuming pens still cost \$1 each and pencils now cost \$10 each

$$\boxed{x_2 = 10 - 10x_2}$$

Q1. Individual and Market Demand

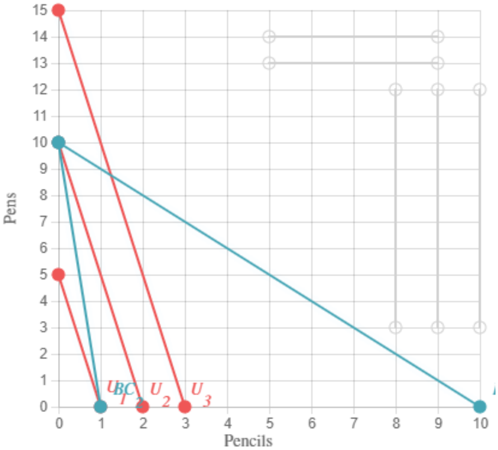

Figure: Perfect substitutes

Contents

Q1. Utility Maximization

Suppose that there are two goods, X and Y. The price of X is \$2 per unit, and the price of Y is \$1 per unit. There are two consumers, A and B. The utility functions for the consumers are

$$U_A(X, Y) = X^{0.5}Y^{0.5}$$

$$U_B(X, Y) = X^{0.5}Y^{0.5}$$

Consumer A has an income of \$100, and Consumer B has an income of \$300.

Q1. Utility Maximization

- Using Lagrangians, solve for the optimal bundles of goods X and Y for both consumers A and B.

Consumer A's maximization problem is

$$Max\ \ U_A(X,Y) = X^{\frac{1}{2}}Y^{\frac{1}{2}}$$

s.t.

$$100 = 2X + Y$$

Q1. Utility Maximization

The Lagrangian of this problem is

$$\mathcal{L} = X^{\frac{1}{2}}Y^{\frac{1}{2}} - \lambda\left[2X + Y - 100\right]$$

FCO

$$\frac{\partial \mathcal{L}}{\partial X} : \ \frac{1}{2}X^{-\frac{1}{2}}Y^{\frac{1}{2}} - 2\lambda = 0$$

$$\frac{\partial \mathcal{L}}{\partial Y} : \ \frac{1}{2}X^{\frac{1}{2}}Y^{-\frac{1}{2}} - \lambda = 0$$

$$\frac{\partial \mathcal{L}}{\partial \lambda} : \ 2X + Y - 100 = 0$$

Q1. Utility Maximization

Solve for λ in the first two FCO

$$\lambda = \frac{X^{-\frac{1}{2}}Y^{\frac{1}{2}}}{4}$$

$$\lambda = \frac{X^{\frac{1}{2}}Y^{-\frac{1}{2}}}{2}$$

So we can put them together and solve for Y

$$\frac{X^{-\frac{1}{2}}Y^{\frac{1}{2}}}{4} = \frac{X^{\frac{1}{2}}Y^{-\frac{1}{2}}}{2}$$

$$\frac{Y^{\frac{1}{2}}}{X^{\frac{1}{2}}} = 2\frac{X^{\frac{1}{2}}}{Y^{\frac{1}{2}}} \Rightarrow Y = 2X$$

Q1. Utility Maximization

Finally, we can plug the optimal value of Y in the budget constraint

$$2X + 2X = 100 \Rightarrow 4X = 100 \Rightarrow \boxed{X = 25}$$

$$Y = 2X \Rightarrow Y = 2(25) \Rightarrow \boxed{Y = 50}$$