# 1 Market Equilibrium

**Equilibrium** A point at which neither consumers nor producers want to change their behavior.

**Excess Demand** The amount by which quantity demanded exceeds quantity supplied. If there is excess demand then there is a *shortage*, which puts upward pressure on prices.

**Excess Supply** The amount by which quantity supplied exceeds quantity demanded. If there is excess supply then there is a *surplus*, which puts downward pressure on prices.

Equilibrium occurs at the point where quantity supplied equals quantity demanded $\Rightarrow Q^D(p) = Q^S(p)$.

# 2 Taxes

***Ad Valorem* Tax** For every dollar a consumer spends, they also pay a fraction $\alpha$ to the government. $\alpha$ is called the *ad valorem* tax rate.

**Unit Tax** A specified dollar amount $\tau$ is collected for each unit of output.

It does not matter from who the tax is collected:

- If the tax is collected from sellers $\Rightarrow p_{\text{sellers}} = p_{\text{buyers}} - \tau$.
- If the tax is collected from buyers $\Rightarrow p_{\text{buyers}} = p_{\text{sellers}} + \tau$.
- $p_{\text{sellers}} = p_{\text{buyers}} - \tau \Leftrightarrow p_{\text{buyers}} = p_{\text{sellers}} + \tau$

The tax creates a 'wedge' between the supply and demand curve. An equilibrium with a unit tax occurs when

$$Q^D(p_{\text{buyers}}) = Q^S(p_{\text{buyers}} - \tau) \Leftrightarrow Q^D(p_{\text{sellers}} + \tau) = Q^S(p_{\text{sellers}})$$

Who bears the incidence of a tax depends on relative elasticities:

- If supply is more inelastic than demand, then sellers will bear more of the tax. If supply is perfectly inelastic, then sellers bear the complete incidence of the tax.
- If demand in more inelastic than demand, then buyers will bear more of the tax. If demand is perfectly inelastic then buyers bear the complete incidence of the tax.
- $\Delta p_b = \dfrac{\eta}{\eta - \varepsilon}\Delta\tau$

# 3 Consumer Preferences

Properties of Consumer Preferences:

1. **Completeness** Given two bundles, a consumer can always decide which one they prefer (or if they are indifferent).
2. **Transitivity** If bundle A is better than B, and B is better than C, then A is better than C.
3. **Free Disposal** More is always better, because we can always throw away whatever we don't want.

**Indifference Curve** The set of all bundles for which a consumer is *indifferent*, or which they consider equally desirable.

Properties of Indifference Curves:

1. Indifference curves represent preferred bundles as you move in northeast direction.
2. Every bundle has an associated indifference curve.
3. Indifference curves can never cross.
4. If both items are 'goods', then indifference curves slope downwards.

# 4 Utility

**Utility** A set of numerical values that reflect the relative rankings of various bundles of goods. The values don't mean anything, only their relative *ranking*.

**Marginal Utility** The additional utility a consumer would get if they consumed one more unit of a good. Marginal utility can be calculated by taking the partial derivative with respect to the good.

$$MU_x = \frac{\partial U}{\partial x}$$

**Marginal Rate of Substitution** How much of good $y$ a consumer would give up in order to get an additional unit of good $x$. Essentially how much good $x$ is 'worth' in units of good $y$.

$$MRS = -\frac{\frac{\partial U}{\partial x}}{\frac{\partial U}{\partial y}} \approx \frac{\Delta y}{\Delta x}$$

Indifference curves are usually convex, because the marginal utility of a good usually decreases as we consume more of it. However, there are two types of goods that have unique indifference curves.

- **Perfect Substitutes** Goods for which a consumer is completely indifferent as to which to consume. Perfect substitutes have straight line indifference curves.
- **Perfect Complements** Goods that a consumer consumes only in fixed proportions. Perfect complements have L-shaped indifference curves.

# 5 Exercises

1. Let the quantity demanded of UC Davis basketball tickets be given by $Q^D(p) = 200 - 4p$ and the quantity supplied be given by $Q^S(p) = 5p - 70$.

   (a) What is the equilibrium price and quantity?

   $$Q^D(p) = Q^S(p) \Leftrightarrow 200 - 4p = 5p - 70 \Leftrightarrow 9p = 270 \Leftrightarrow p = 30$$

   $$Q = 200 - 4 \cdot 30 = 80 \quad \text{or} \quad Q = 5 \cdot 30 - 70 = 80$$

   (b) What is the elasticity of demand, $\varepsilon$?

   $$\varepsilon = \frac{\partial Q^D}{\partial p}\frac{p}{Q} = -4 \cdot \frac{30}{80} = -\frac{3}{2}$$

   (c) What is the elasticity of supply, $\eta$?

   $$\eta = \frac{\partial Q^S}{\partial p}\frac{p}{Q} = 5 \cdot \frac{30}{80} = \frac{15}{8}$$

   (d) Suppose the university wants to throw a parade to celebrate the fact that the basketball team is first place in the Big West. They need to raise \$500 to rent bike-powered floats. In order to do so, they propose taxing fans \$9 per ticket. What is the price fans will end up paying? What is the price sellers will end up receiving? Will the university raise enough money for the parade?

   $$Q^D(p_b) = Q^S(p_b - 9) \Leftrightarrow 200 - 4p_b = 5(p_b - 9) - 70 \Leftrightarrow 270 = 9p_b - 45 \Leftrightarrow 9p_b = 315 \Leftrightarrow p_b = 35$$

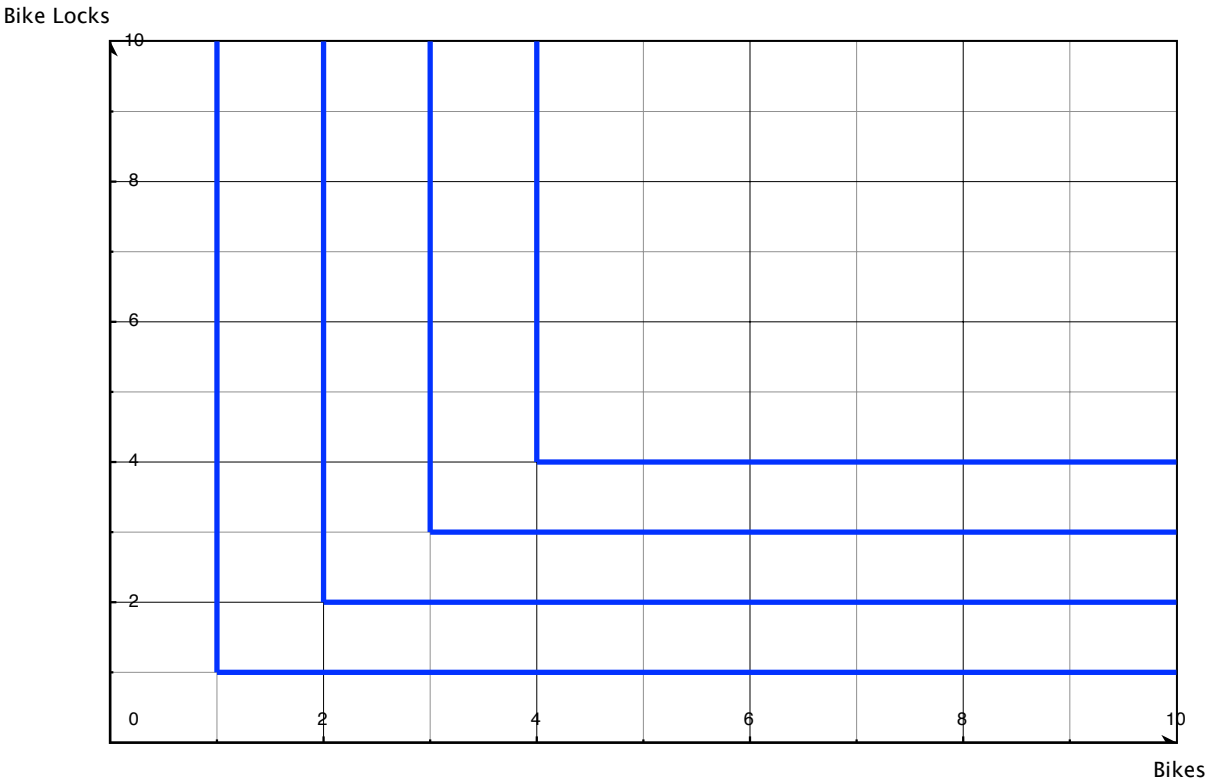
   $$p_s = p_b - 9 = 26$$

   $$Q = 200 - 4 \cdot 35 = 60$$

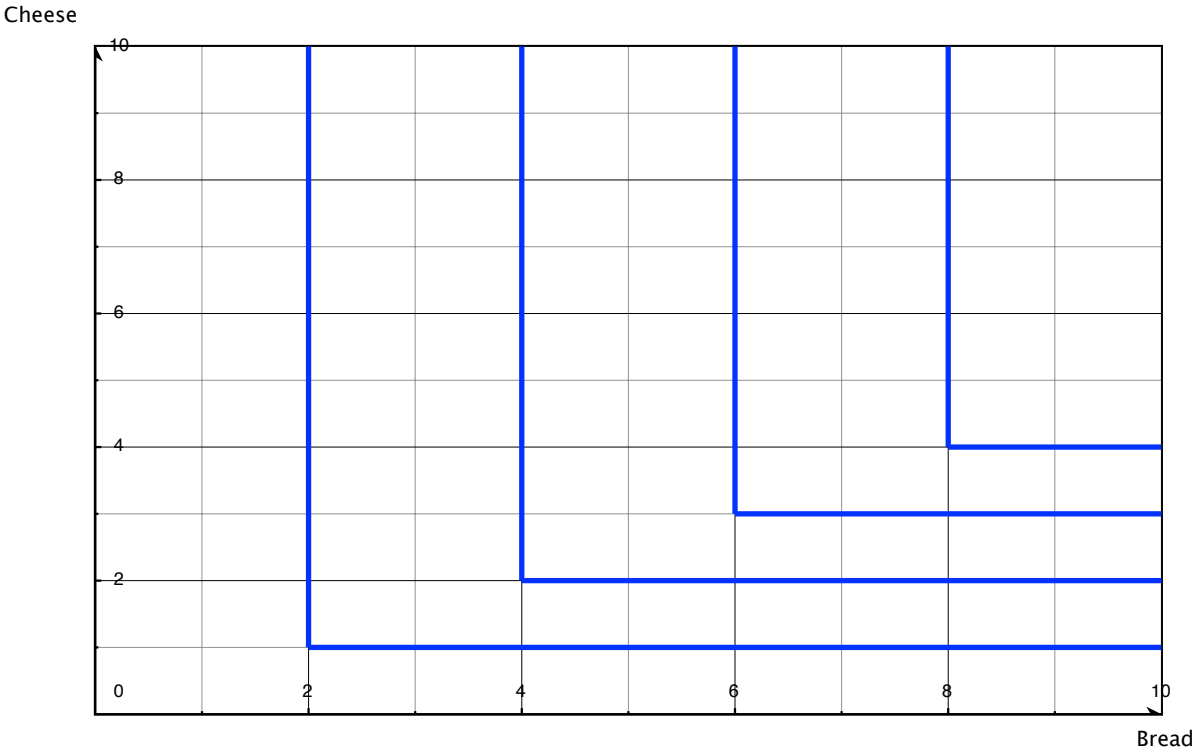
$$\text{Tax Revenue} = \tau Q = 9 \cdot 60 = 540$$

The university will be able to hold the parade.

2. (a) Bikes and bike locks are perfect complements. Everyone in Davis knows that a bike without a lock will not be your bike by tomorrow, and a lock without a bike is just extra weight. Preferences for bikes and bike locks can thus be denoted by $U(b, l) = \min\{b, l\}$, where $b$ is number of bikes and $l$ is number of locks. Draw some indifference curves for these preferences, with bikes on the horizontal axis.




(b) For making sandwiches, bread and cheese are also perfect complements. Suppose you like closed face sandwiches which require 2 slices of bread for every slice of cheese. Preferences for bread and cheese can thus be denoted by $U(b, c) = \min\{0.5b, c\}$, where $b$ is slices of bread and $c$ is slices of cheese. Draw some indifference curves for these preferences, with bread on the horizontal axis.




(c) What is the difference between the indifference curves?

Both sets of preferences give L-shaped indifference curves. However the slope of the line going through the kink points for bread and cheese is flatter. This represents the fact that we need twice as much bread to get utility out of another slice of cheese, where we need only one more bike to get utility out of a lock.