A demand curve is a relationship between the quantity of a desired item and the willingness to pay (WTP).

One feature of a demand curve that we’ll be particularly interested in is the consumer surplus.

Consumer surplus is the difference between WTP and price for all units purchased.

The demand curve can be read in one of two ways.

Either $q$ or $p$ can be viewed as the dependent variable and the other as the independent variable, though the usual way is with price as the independent variable.
To see how much demand changes with changes in price we are interested in the slope of the demand curve, i.e. $\frac{dq}{dp}$.

The problem with that is slopes are sensitive to units of measurement.

To determine price/quantity relationships that are “unit free”, we work with the **elasticity of demand**.

The **elasticity of demand** is the percentage change in quantity demanded over the percentage change in price:

$$\epsilon = -\frac{d \log q}{d \log p} = -\frac{dq}{dp} \frac{p}{q}$$
We’ll think of a firm as a process of transferring inputs into outputs.

The efficiency of this process is reflected in the firm’s cost function.

Some (hopefully) familiar cost concepts:

- Fixed Cost FC: The cost that does not depend on output level.
- Variable Cost VC: The cost which is 0 if there is no output.
- Total Cost TC: Sum of fixed and variable costs.
- Average Cost AC: Total cost divided by total output.
- Marginal Cost MC: The cost of an additional unit. $\frac{dTC}{dq}$. 
Some of these cost values vary with a particular value of output.

By computing AC and MC for each value of output we get the AC and MC functions.

Which cost concept is appropriate to work with depends on what we are interested in:

- **MC** is appropriate in deciding how much to produce.
- **AC** is appropriate concept when deciding whether to produce or not.

Relating the two concepts we can define a firm’s supply function as the MC function for values of price greater than the minimum of AC.
Other cost concepts will be important for this class:

- **Opportunity Cost** is the forgone benefit from not applying the resource in the best alternative use.
- **Sunk cost** is an investment in an asset with no opportunity cost.

From an economic decision making point of view, sunk costs should not be taken into consideration.

They should be made on the concept of **economic cost**.

**Economic costs** differ from expenditures in two ways:

1. It includes opportunity costs that do not correspond to expenditure.
2. It excludes expenditures that correspond to sunk costs.

Sunk costs will be prevalent in this class.

As we’ll see, this is because of their **strategic commitment value**.
Features of cost functions in a given industry will be useful in understanding the structure of the industry.

The concept of **scale economies** will help explain why some industries are more concentrated than others.

There are **economies of scale** if average cost declines with output. If it does not vary we say there are **constant returns to scale**.

If average costs increase with output we say there are **diseconomies of scale**.

A related cost concept is **minimum efficient scale**- the lowest output level at which minimum average cost is attained.

Lastly, an important cost concept is **economies of scope**. Here, the cost of producing outputs $q_1, q_2$ together is lower than the cost of producing them separately.
Firm’s profits are given by revenue minus total costs. For a given output level $q$ we have

$$\Pi(q) = R(q) - C(q)$$

What level of $q$ maximizes profit?

The first order condition sets the derivative of the profit function to 0.

Note since differentiation and differencing can be interchanged, we have at the profit maximizing level of output:

$$MR = MC$$

where $MR$ denotes marginal revenue.

Note total revenue is $pq$, and $MR$ is the derivative of this with respect to $q$:

$$MR = \frac{d}{dq}pq = \frac{dp}{dq}q + p$$
which we can simplify to

$$MR = p \left( 1 - \frac{1}{\epsilon} \right)$$

Note this implies that marginal revenue is lower than price.

However, in perfectly competitive markets, $\epsilon = \infty$, so marginal revenue = price.

So by our above condition $MC = price$ in perfectly competitive markets.
Basic Micro: Efficiency

- Recall the **consumer surplus** is the difference between willingness to pay and price.
- On the other hand **producer surplus** is the difference between the price and the cost to produce.
- We can aggregate across transactions to get **total consumer surplus** and **total producers surplus**.
- **Total surplus** is the sum of these two.
- This notion will let us define 3 notions of efficiency:
Allocative Efficiency: requires that resources be allocated to their most efficient use. It is measured by total surplus. Maximum allocative efficiency is achieved at the point where marginal cost equals willingness to pay.

Productive Efficiency: refers to how close the actual production cost is to the lowest cost achievable.

Dynamic Efficiency: refers to the rate of introduction of new products as well as the rate of improvement of existing production techniques.