# Calculus 2

MATH 128

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# Chapter 1

# Supply and Demand

## 1.1 Demand

**Demand** is the quantity of something we want, and the ability to procure.
What impacts our demand?

1. Price
    - Higher price → lower demand
2. Utility and preference
    - Higher utility → higher demand
3. Price of alternatives
    - Higher demand of complementary goods → higher demand
    - Higher demand of substitute goods → lower demand
4. Income
    - Higher income → higher demand
5. Expected future price
    - Higher expected future price ↔ higher demand
    - Price doesn't actually need to change for demand to be affected
6. Information
    - What people know affects demand
    - Creates self-fulfilling prophecies
7. Government interventions
    - Restrictions → lower demand

(The "law" of demand) If prices go up, demand goes down, and vice versa.
Luxury goods violate this.
How can we represent demand?

1. Graph
    - Price on $y$-axis
    - Quantity on $x$-axis
    - Generally downwards sloping
    - Best for presentation
2. Function

- A function that maps independent variables (price, income, etc.) to quantity demanded
- More precise, good for prediction
- Can use more than one factor at once

$$D(p) = (-)p$$

### 1.1.1 Supply

What impacts supply?

1. Costs of inputs
   - Higher costs → lower Supply
2. Price
   - Higher prices → higher supply
3. Government interventions

How can we represent supply?

$$S(p, c) = (+)p + (-)c$$

### 1.1.2 Summing supply & demand

- Add horizontally

When can we use the supply & demand model?

1. Minimal to no frictions
2. Full information
3. Everyone is a price taker
4. Identical products

### 1.1.3 Solving the supply & demand model

Find the quantity and price where $Q_D = Q_S$, or quantity supplied equals quantity demanded.
For graphs, find where supply & demand interesects.
For functions, set $Q_D = Q_S$ and solve for $p$.

### 1.1.4 Competitive model

[Market structure]

- Number of firms in the market
- Ease with which firms can enter/exit
- Ease with which firms can differentiate their products

[Perfectly competitive market] A market in perfect competition has the following properties:

- Numerous small firms
- Easy entry and exit
- Difficult to differentiate
- Everyone is a price taker
- Everyone is profit maximizing (a legal responsibility)
- Firms are competitive in the short run and in the long run

In a perfectly competitive market, the market has normal supply and demand curves. For firms, the demand is perfectly elastic at the market price (residual demand) because they are price takers.

### 1.1.5 Profit

$$\text{Profit} = R(q) - C(q) = \pi$$

Economic profit also considers opportunity cost, the value of the best foregone alternative.

Firm profit vs quantity graphs look like a parabola. There is an optimal quantity that maximizes firm profit.

Options to maximize profit:

1. Choose $q$ that maximizes profit
2. Find $q$ for which marginal profit is 0
3. Find $q$ for which marginal cost is equal to price

The term **marginal** represents the value of a 1 unit increase.

### 1.1.6 Costs

## 1.2 Taxes, Tariffs, Surplus

### 1.2.1 Surplus

**Surplus** is the value gained from buying/selling something for less/more than its worth to you.

Supplier surplus refers to the area above $S$ but below $p$.

Consumer surplus refers to the area below $D$ but above $p$.

There are two types of tax:

- Per unit (fixed tax rate)
- Ad Valorem (percent tax rate)