

# Intermediate Microeconomics — ECO 3101

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Professor Boyd

Jan. 10-12, 2023

## 0.1 Basic Course Information

**Syllabus:** There is a link to the full (public) syllabus via Canvas, at the end of of the Canvas syllabus page. For a direct link, use:

<http://faculty.fiu.edu/~boydj/3101.html>

**Textbook:** The textbook is Goolsbee, Levitt, and Syverson, *Microeconomics*, 3rd ed., Worth publishers. It's ok to use an older edition. The changes in the part we use are not that large.

**Office Hours:** If you have questions, you may ask immediately after class, or come to my office. Regular office hours are 12:45-1:45pm and 3:30-4:45pm on Tuesdays and Thursdays. I will be happy to make an appointment for another time if that is more convenient. My office is DM-311A, my office phone number is 305-348-3287, and my email is **John.Boyd@fiu.edu** or **boydj@fiu.edu**. Sending it directly is preferred. Email sent via Canvas is subject to delays.

## 0.2 Quizzes, Final, and Grades

### 0.2.1 Quizzes

Your grade will be based on biweekly quizzes and a final exam. There is no midterm.

Six short quizzes will be given during the last 30 minutes of class. They consist of 10 multiple choice questions and will be given on every other Thursday, beginning on Jan. 26. The quizzes will be over the material covered in the previous two class weeks, both from class and the book.

The quiz dates are: Jan. 26, Feb. 9, Feb. 23, Mar. 16, Mar. 30, and Apr. 13. The quizzes will focus on the material covered since the previous quiz (usually, the previous two class weeks). Your lowest quiz score will be dropped, and your total quiz grade will be based on your **top 5 quiz scores**. Your quiz letter grade will count for **70%** of your grade.

Sample quizzes can be downloaded from the public online syllabus.

### 0.2.2 Missed Quizzes

Since your grade is based on the top 5 quizzes, you are allowed to miss one quiz without penalty. If you miss a second quiz, you should contact me as soon as possible to arrange a makeup. Unless there are very special circumstances, such as having to miss the final due to the coronavirus, missing three or more quizzes or the final will mean an automatic F in the course.

### 0.2.3 Final Exam

The final will be at the officially scheduled time and date. This is currently scheduled for **5-7 pm on Tuesday, April 25, 2023** here in DM-110. It will be comprehensive. The final counts for 30% of your course grade.

The final will consist of 30-35 multiple choice questions.

### 0.2.4 Calculating your Course Grade

I average your letter grades for the quizzes and final using weights of 70% and 30%. To do this, I convert letter grades to numbers using a 12-point scale. Thus A+ = 12, A = 11, A- = 10, etc., with F = 0. For example, if you got a B (=8) on the quizzes and an A (=11) on the final, your average is  $.7*8 + .3*11 = 8.9$ . This rounds to 9, which is a B+.

As of Fall 2016, the official FIU grading scale does not include A+, C-, D+, or D- as course grades. Those will be rounded down to obtain the official course grade.

### 0.2.5 Incompletes

We strictly follow university policy concerning incompletes. This means that incompletes will only be considered when an emergency prevents you from attending the final exam.

Missing the final due to Coronavirus will be considered grounds for an incomplete.

## Intermediate Microeconomics – ECO 3101

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### 1.1 What does economics study?

You've probably encountered various of economics. Many of them likely had considerable truth to them. But were they complete? Assuming not, I'm going to answer that by saying economics studies economies. You might think that means just economies that correspond to political units, the US economy, the UK economy, the Florida economy, the EU economy. But we see economies form, apparently on their own in other settings, in mining camps prior to statehood (no law!), in prisoner of war camps, and in other places where there is not an organized system of law or organized markets<sup>1</sup> The market (and law) just appear. They are social phenomena created by the people involved. They are not handed down from the king or government or even God (think Moses's tablets).

That social phenomena such as markets or law would arise from human behavior, not in a designed fashion, but through a process of evolution via the interactions of many individuals, was something that was only realized in the 18<sup>th</sup> century.<sup>2</sup> This not only applies to economics, but also other social constructions such as language.

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<sup>1</sup> R.A. Radford (1945), The economic organisation of a P.O.W. camp, *Economica*, **12** 189–201.

<sup>2</sup> The idea that individuals pursuing their own interests could lead to general benefits was first suggested by Bernard Mandeville in his 1705 poem, *The Grumbling Hive: or, Knaves turn'd Honest*. He later expended on this in his 1715 book, *The Fable of the Bees: or, Private Vices Publick Benefits*.

### 1.1.1 Adam Smith on the Division of Labor

One of the first to try to systematically analyze the economic order was Adam Smith (1723–1790) in his 1776 book, *An Inquiry into the Nature and Causes of the Wealth of Nations*. He starts by considering the division of labor, partly based on an example of a pin factory from Denis Diderot's *Encyclopédie*.<sup>3</sup>

“One man draws out the wire, another straightens it, a third cuts it, a fourth points it, a fifth grinds it at the top for receiving the head; to make the head requires two or three distinct operations; to put it on, is a peculiar business, to whiten the pins is another; it is even a trade by itself to put them into the paper; and the important business of making a pin is, in this manner, divided into about eighteen distinct operations, which, in some manufactories, are all performed by distinct hands.” — Adam Smith, *The Wealth of Nations* (1776), Bk. 1, Chap. 1.

The division of labor creates higher productivity than would be possible without specialization. Elsewhere, Smith discusses how the division of labor is limited by the size of the market.<sup>4</sup>

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<sup>3</sup> Smith's account of the pin factory was partly based on an article by Delaire in Denis Diderot *Encyclopédie, ou dictionnaire raisonné des sciences, des arts et des métiers* (1751–1766). This was somewhat more accurately described by Adam Ferguson in *Principles of Moral and Political Science* (1792). The origins of Smith's comment were recently investigated by Jean-Louis Peaucelle and Cameron Guthrie (2011) How Adam Smith found inspiration in 4 French texts on pin making in the eighteenth century, *Hist. Economic Ideas* 3, pp. 41–67.

<sup>4</sup> The relation between the division of labor and the extent of the market had earlier been noted by Henry Martyn (1701) Considerations upon the East-India Trade.

### 1.1.2 Adam Smith on Incentives

Right away, Smith gets to the heart of the matter. That the economic order is formed by the actions individuals take in response to incentives, particularly those created by prices.

**“It is not from the benevolence of the butcher, the brewer, or the baker, that we expect our dinner, but from their regard to their own interest. We address ourselves, not to their humanity but to their self-love, and never talk to them of our own necessities but of their advantages.** Nobody but a beggar chuses to depend chiefly upon the benevolence of his fellow-citizens. Even a beggar does not depend upon it entirely. The charity of well-disposed people, indeed, supplies him with the whole fund of his subsistence. But though this principle ultimately provides him with all the necessaries of life which he has occasion for, it neither does nor can provide him with them as he has occasion for them. The greater part of his occasional wants are supplied in the same manner as those of other people, by treaty, by barter, and by purchase. With the money which one man gives him he purchases food. The old cloaths which another bestows upon him he exchanges for other old cloaths which suit him better, or for lodging, or for food, or for money, with which he can buy either food, cloaths, or lodging, as he has occasion.”  
— Adam Smith, *The Wealth of Nations* (1776), Bk. 1, Chap. 2.

We speak to the self-interest of the butcher, brewer, and baker, by offering them money, money which they can later use to purchase goods that will make them better off.

Smith’s idea, is that it is this appeal to self-interest that leads to economic organization, that creates the economy itself.

### 1.1.3 Adam Smith's Invisible Hand

Adam Smith realized that the effect of each individual pursuing his own interest was to promote the economy as a whole.

“As every individual, therefore, endeavours as much as he can both to employ his capital in the support of domestick industry, and so to the direct that industry that its produce may be of the greatest value; every individual necessarily labours to render the annual revenue of the society as great as he can. He generally, indeed, neither intends to promote the publick interest, nor knows how much he is promoting it. By preferring the support of domestick to that of foreign industry, he intends only his own security; and by directing that industry in such a manner as its produce may be of the greatest value, he intends only his own gain, and he in this, as in many other cases, led by an invisible hand to promote an end which was no part of his intention. Nor is it always the worse for the society that it was no part of it. By pursuing his own interest he frequently promotes that of the society more effectually than when he really intends to promote it.” — Adam Smith, *The Wealth of Nations* (1776), Bk. 1, Chap. 2.

In the 1950's economists found ways to build mathematical models of economies and discovered that Smith's perceptions were basically correct.

## 1.2 What is Economics?

One of the best answers is that of Lionel Robbins (1932).<sup>5</sup>

**Economics** is a science that studies human behavior as a relationship between limited resources and unlimited wants which have alternative uses.

### 1.2.1 Economic science uses the methods of science

We create theories, and models based on our theories. We confront these theories and models with data. We revise our theories accordingly, and repeat.

Much economic data is numerical, and is analyzed using statistical methods (econometrics). We will see that type of data collected is connected to our economic theories. In particular, we will see that price indices are derived from our theory of consumer behavior in chapters 4 and 5.

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<sup>5</sup> Lionel Robbins (1932), "An Essay on the Nature and Significance of Economic Science", London, Macmillan.



## 1.2.2 Unlimited Wants and Scarcity

We model consumers and producers in terms of what is valuable to them: **Profit** in the case of producers (chapters 6, 7, and 8), and what we call **utility** in the case of consumers (chapter 4 and 5). Utility is a way of numerically summarizing the value consumers get from consumption.

Because our wants, our desires, are **unlimited** and most of our resources, our means, are **limited**, every person and every society faces the problem of **scarcity**—there are not enough resources to satisfy all of our desires.

Scarcity means we always face **tradeoffs** and must **set priorities** and **make choices**. The tradeoffs usually change with consumption or production, so priorities are conditional rather than absolute. E.g., I will value a glass of water more after exercising in hot weather than while working at my desk in an air conditioned room.

### 1.2.3 Opportunity Cost

The fact that resources have alternative uses gives us a notion of cost, what we have given up. This is the idea of **opportunity cost**. The cost of any choice is the most valuable alternative that we have foregone.

When we spend an evening studying economics, we have given up many possibilities. We could have used that time to study international relations, or to spend time with friends, lovers or family, to earn some extra income, to exercise, to catch up on our sleep, or any of many other possibilities.

The alternative that is the most valuable to you is your **opportunity cost**.

In many cases we can measure opportunity cost in dollar terms, allowing easier comparison between activities.

### 1.2.4 Optimization

To make our choices, we must evaluate the tradeoffs we face. What do we gain or lose? In economic problems, we are usually able to reduce the costs and benefits to dollar terms.

Both logic and mathematics teach us we can solve this type of problem by looking at incremental costs and benefits. If the increments are small, we call these marginal cost (MC) and marginal benefit (MB). To get the largest value from our resources, we must set  $MC = MB$ .

One way of seeing this is that if marginal cost and benefit of an activity obey  $MB > MC$ , it means that we get more net benefit by doing more of the activity. If  $MB < MC$ , our net benefit falls when we do more.

Together these mean that if  $MB \neq MC$ , we are not doing as well as we can. The optimum must have

$$MB = MC.$$

Although this is necessary for an optimum, it may not be enough.

### 1.2.5 Optimization via Calculus

This is well known from calculus. If we are choosing how much of a product to buy, we should think about its costs (what we pay for it, which stands in for the value of what we could otherwise purchase, our opportunity cost) and about the benefits we receive, our utility gain (measured in dollars). If we buy a quantity  $q$ , we could write its value to us as

$$B(q) - C(q)$$

Calculus tells us that if this is differentiable, maximizing our gain requires setting the derivative to zero:

$$B'(q) - C'(q) = 0, \quad \text{or} \quad B'(q) = C'(q).$$

In economic terms, we write this as

$$MB(q) = MC(q).$$

### 1.2.6 Is it a Maximum?

We do have to use care when using the  $MB = MC$  rule. Calculus actually teaches us that the first derivative is zero at both maxima and minima.

In calculus, we usually can resolve this by checking the second derivative.

In economics, the logic of the problem often tells us that there is only one place where  $MB = MC$  and that is the maximum (we will see an exception in the theory of the firm).

Usually, the marginal benefit is shrinking, and the marginal cost rising, so that the net benefit,  $B(q) - C(q)$  is always falling. This means it can only be zero once, at a unique value of  $q$ .

### 1.2.7 Scarcity

The concept of scarcity is central in economics, doubly so in microeconomics. The theory of the consumer is built around scarcity. Consumers have limited means, and must make their choices from those they can afford. Consumer desires translate to a utility scale and consumers pick the best available option, the one with the highest utility. We will study this idea further in chapters 4 and 5.

The concept of opportunity cost is closely related to scarcity. It only makes sense when there is a tradeoff. If we could get more of all we want, we wouldn't face any tradeoffs.

The idea of opportunity cost was introduced by the French economist and author Frederic Bastiat (1801-1850) in his essay, *What is Seen and What is Not Seen* (1850). The term "opportunity cost" wasn't introduced until 1914 by Friedrich von Wieser (1851–1926).

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### **1.2.8 Producers and Scarcity**

Producers don't directly face scarcity in standard microeconomic models, but it is reflected in the prices they face and in the fact that in general market equilibrium, where all markets clear (i.e., quantity demanded equals quantity supplied) they are limited by what is available in input markets. And this is ultimately limited by the economic resources available to the economy. General equilibrium is introduced in chapter 15. Regrettably, we will not have time to cover it.

### **1.2.9 Scarcity in Macroeconomics**

There is one major exception to the assumption of scarcity in macroeconomics, and that is the Keynesian theory of recession and depression, which posits the existence of unused resources.

Keynes was very clear that this was an unusual situation. He thought that something was preventing these resources from being used. He was quite unclear about what it was. One alternative interpretation is that markets are in the process of being restructured, and resource owners, including workers, are waiting for more clarity before committing to a new line of business or a new career.



### **1.2.10 Denial of Scarcity**

The other places in economics that we see scarcity ignored are more quackery than serious economics.

There are Marxian inspired works that see scarcity as a due to a conspiracy of capitalists. Marx himself knew better, and wrote eloquently about the accomplishments of capitalism in making the world richer. He thought that capitalism had solved the problem of production, and that socialism would be built upon that solution.

He was mistaken about this. Specifically, he was mistaken that there was a fixed capitalistic solution. Rather, that solution is continually changing as the economic situation changes. What is really needed is the capability to find new solutions, and none of the few socialists who have addressed this have come to grips with that problem.

Since Marx, there have been drastic changes in production. Economies such as the Soviet Union have demonstrated that a command economy lacks the flexibility to deal with a rapidly changing economic environment. The collapse of the Soviet Union seems to have been a case in point.

Part of what Marx saw was that the world was getting wealthier. One measure of this is the number of people not in extreme poverty (income less than \$2 per day, in current US dollars), which tripled during his lifetime. That said, extreme poverty was still the rule rather than the exception. In Marx's era, about 80% of the world's population lived in extreme poverty.

**1.2.11 Denial of Scarcity, continued**

The expansion of market economies has continued since then (globalization) and has brought about a dramatic decrease in world poverty during my lifetime. When I was born, nearly 70 years ago (and 70 years after Marx died), over 60% of the world population still lived in extreme poverty.

Recent progress has been much faster. In spite of a tripling of world population since then, fewer than 10% of people were in extreme poverty in 2019. This is expected to increase temporarily due to the coronavirus pandemic. The overall trend has been strongly downward.

Another type of economic quackery that denies scarcity calls itself Modern Monetary Theory. It suffers from the delusion that scarcity can be eliminated by simply printing more money. Most of us expected printing more money to bring more inflation, and that is exactly what happened, as it has so many times in the past.

### **1.2.12 Robbins Again**

Recall Lionel Robbins (1932) definition of economics:

Economics is a Science that studies human behavior as a relationship between limited resources and unlimited wants which have alternative uses.

Economics studies human behavior in its relation to means and ends, resources and wants. In this course we focus on human behavior connected to market activity: Consumption and production, buying and selling.

One important example of this is the supply and demand model of chapters 2-8. Other examples include monopoly markets (chapters 9-10) and other markets with limited competition (oligopoly, chapter 11).

**1.2.13 Is Robbins's Definition Too Broad?**

One early criticism of Robbins's definition was that it was too broad, that it could include many topics that were outside of economics. But times have changed. It turned out that this definition also included a research program of applying economics beyond its traditional boundaries. That research program has been quite successful, justifying the broad definition.

**1.2.14 Not Any More!**

Modern economics has been applied not just to allied fields such as finance, but to a variety of social sciences, and even biology.

Successes include economic theories of:

- Marriage and families (sociology)
- Crime and punishment (criminology)
- Population growth (demography, environmental science)...this one goes all the way back to Thomas Malthus's Essay on the Principle of Population (1798)
- Voting and rational choice models in political science.
- Behavioral Economics (boundary of psychology and economics)
- War and Peace (political science, military science)
- Evolutionary Theory (biology)

The last two topics typically involve game theory, which we will study in chapters 11 and 12.

### 1.2.15 What is Microeconomics?

**Microeconomics** focuses on the economic behavior of individual consumers and firms in specific markets, or collections of markets. This course covers price formation, quantity traded, gains from trade (using consumer's and producer's surplus), effects of taxation and price controls, theory of the consumer, theory of the firm, equilibrium in competitive markets, monopoly markets, imperfectly competitive markets, game theory, and a bit about decisions over time and decisions under uncertainty.

Generally speaking, questions involving the economy as a whole (business cycles, economic growth, inflation and deflation) belong to **macroeconomics**.

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### **1.3 What is a Market?**

Microeconomics in general, including the supply-demand model, focus on individual markets. But what is a market??

### **1.3.1 Defining Markets**

A market is a social institution that helps buyers and sellers come together to make transactions. Its key features include:

1. A way for would-be buyers and sellers to agree on terms
2. A method for delivering goods.
3. A method for making payments.

These apply whether we are discussing a medieval market fair, a supermarket, stock and option markets, or online markets such as Amazon or eBay.



### 1.3.2 Creating Markets

*“order is not a pressure imposed upon society from without, but an equilibrium which is set up from within” — Ortega y Gasset<sup>6</sup>*

Markets are not God-given, they are created by people. Sometimes informal means are enough. Other times, social institutions must be created to support them. The legal framework is particularly important.

Sometimes informal rules, agreed on by people in a particular location are enough. There needs to be agreement on who owns what, both before and after trade. Prior to statehood, and usually in the absence of any organized government (state or territorial), miners in the western US were able establish systems for making mining claims amongst themselves, and enforce it against claim-jumpers (sometimes at gunpoint, sometimes with community action).

Elinor Ostrom (1933-2012), Nobel Laureate 2009, spent much of her career studying informal markets and supporting institutions, especially as applied to management of common property resources such as fisheries.

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<sup>6</sup> Mirabeau o el político

### 1.3.3 Standardizing Commodities

Sometimes institutions are more formal. The Chicago Board of Trade had to introduce a grading system for farm commodities, standardizing them, to make futures trading possible.

A good description of this is in William Cronon's, *Nature's Metropolis: Chicago and the Great West* (1992). I'll just borrow what Wikipedia says: "In one chapter, he details how grain became a standardized commodity. At first farmers sold it in sacks with the farm's family name stamped on it; as a commodity, it was sold in bulk as a standardized good stored in silos according to grade."

### **1.3.4 What was the Aluminum Market?**

In microeconomics we mostly focus on markets for single goods (including services). Defining a particular market is sometimes contentious. The antitrust case, *US vs. Alcoa* (1945) is one such example (the case had been ongoing for years).

An important component of the decision was Judge Learned Hand's discussion of what the relevant market was. Did the relevant market consist of the general aluminum market, or only the market for virgin (non-recycled) aluminum?

From an economic point of view, it's hard to justify the narrow view, that only virgin aluminum counts. But law and economics sometimes disagree—and *Alcoa* one of those cases. Judge Hand took the narrow view when declaring *Alcoa* an illegal monopoly.

## 2. Chapter 2: Supply and Demand

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### 2.1 The Supply and Demand Model

Jan. 12, 2023

The Supply and Demand Model is the basic model of microeconomics.

The supply and demand model:

1. Applies to a single market at a time. It shows how buyer and seller behavior determines market price and quantity.
2. Applies to homogeneous goods, sometimes called commodity goods, goods which consumers treat as identical for all practical purposes.
3. Assumes all participants are well-informed about the prices available and quality of the product.
4. Assumes there are many buyers and sellers, with none dominating the market.

There are 3 basic components to the model, demand, supply, and a graph or equation relating them.

Chapters 2 and 3 focus on the fundamentals of the supply-demand model. Chapters 4 and 5 investigate demand more deeply. Chapters 6, 7, and 8 focus on supply.

## 2.2 Demand

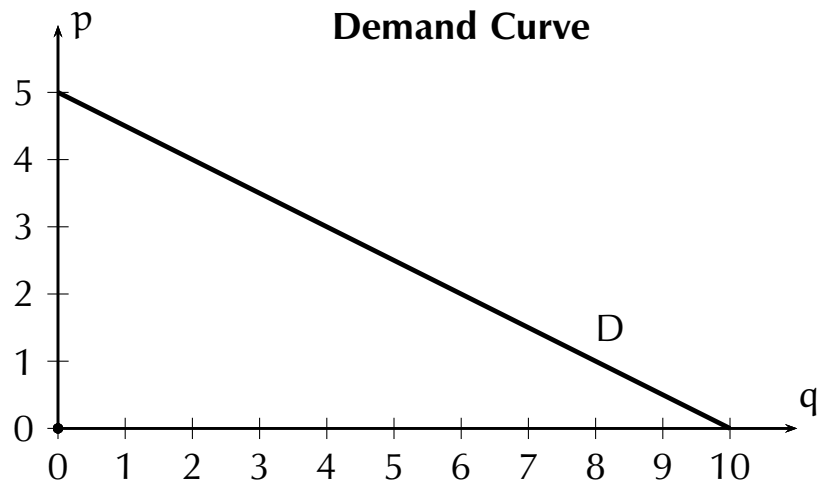
**Demand** refers to the relation between price and the **quantity demanded**—the amount the buyers wish to purchase at that price.

Demand is usually described in one of three equivalent ways:

1. **Demand Schedule:** A listing of prices and corresponding quantities
2. **Demand Curve:** A graph with prices on the vertical axis and quantities demanded on the horizontal axis.
3. **Demand Function:** A function  $q(p)$  that gives the quantity demanded  $q$  for each price  $p$ . Sometimes we prefer to use the *inverse demand function*  $p(q)$ , where price depends on quantity.

### 2.2.1 Law of Demand

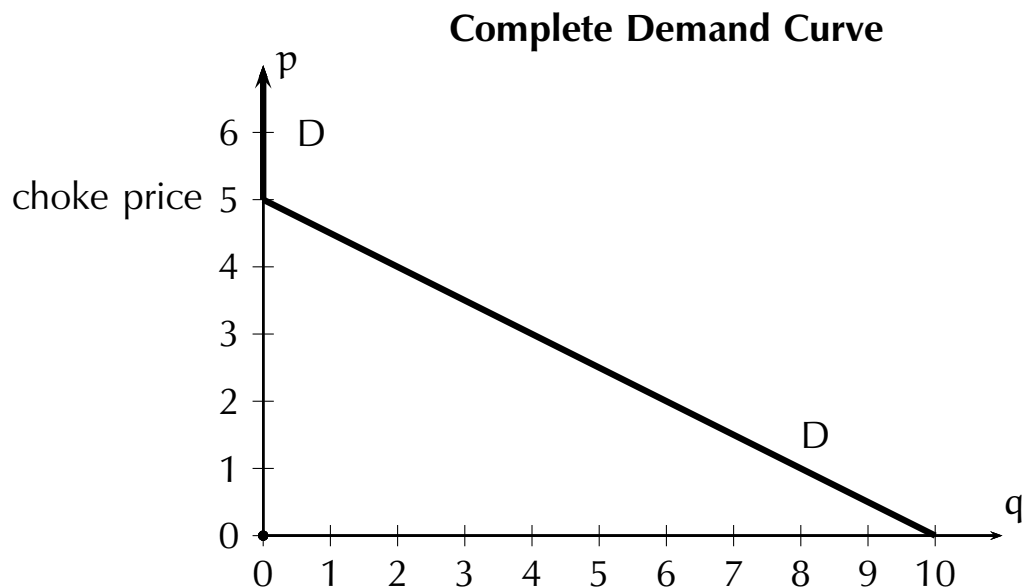
Demand usually obeys the **Law of Demand**—quantity and prices are inversely related. Equivalently, demand curves have a negative slope, as in the diagram below.



### 2.2.2 Interpreting the Demand Curve

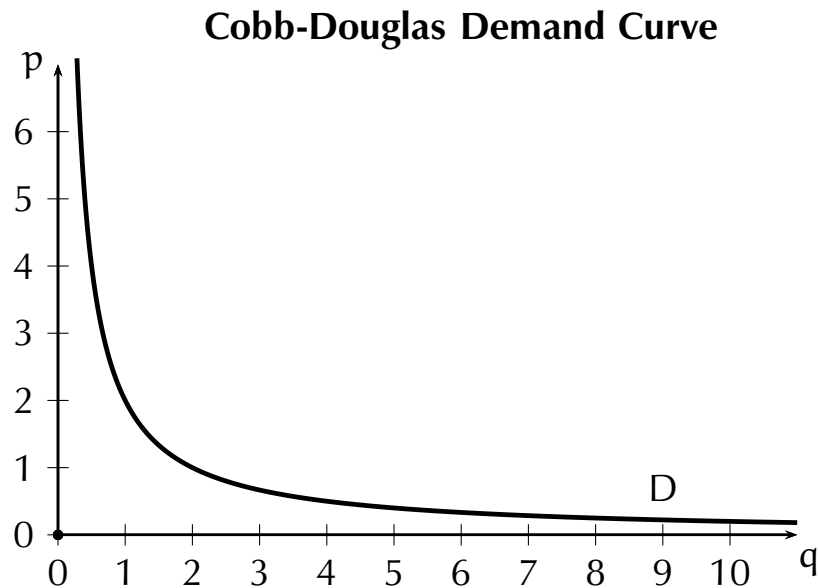
You'll notice that the demand curve hits the vertical axis when  $p = 5$ . That price,  $p = 5$  is called the **choke price** as demand is choked off at that point. We are supposed to interpret the demand curve to mean that the quantity demanded is zero above the choke price, but we rarely draw the curve to include those prices. You're supposed to know that it's there.

The demand curve below is drawn so that prices above \$5 are included. The heavy vertical line is part of the demand curve.



### 2.2.3 Demand without a Choke Price

Demand curves don't have to have choke prices. Here's an example that is based on the theory of the consumer that we develop later (chapters 4 and 5).



If you are curious, this inverse demand function is  $p = 2/q$  with demand function  $q = 2/p$ .

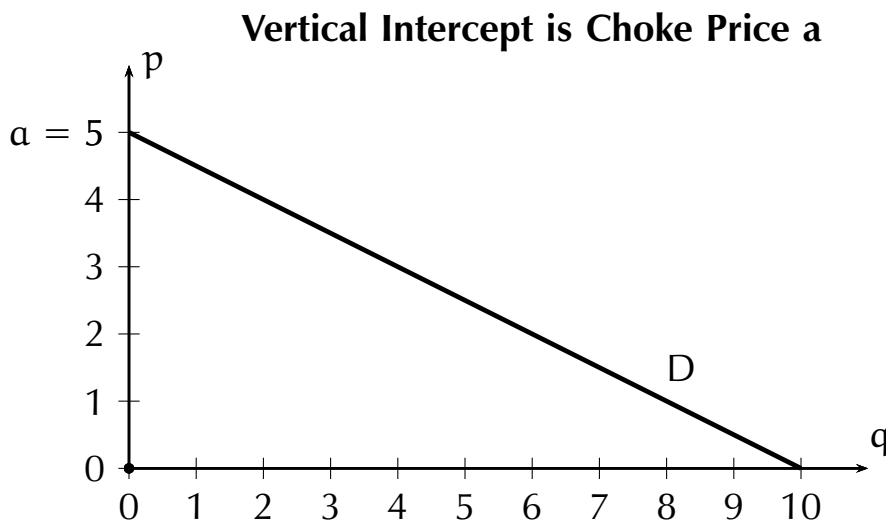


### 2.2.4 Finding Inverse Demand from the Diagram I

We will start with our inverse demand curve, and derive an equation for it. It is a straight line, so we can put it in slope-intercept form,

$$p(q) = a + bq$$

where  $a$  is the vertical intercept (choke price), and  $b$  is the slope.



It is clear that the vertical intercept, the choke price is \$5, so we set  $a = 5$ . The quantity demanded when  $p = 5$  is zero, and it is also zero at all higher prices.

### 2.2.5 Finding Inverse Demand from the Diagram II

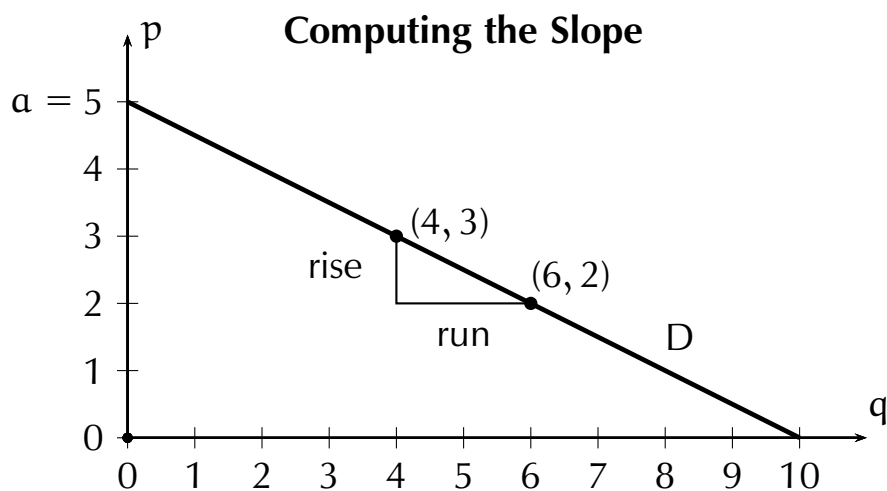
The slope is the rise over the run.

In this case, the rise is  $2 - 3 = -1$  (it falls by 1) and the run is  $6 - 4 = 2$ , so the slope is  $-1/2$ .

That means that the inverse demand function is

$$p(q) = 5 - \frac{1}{2}q.$$

This excludes the vertical portion, which is not a function because there are many values of  $p$  (all  $p \geq 5$ ) when  $q = 0$ .

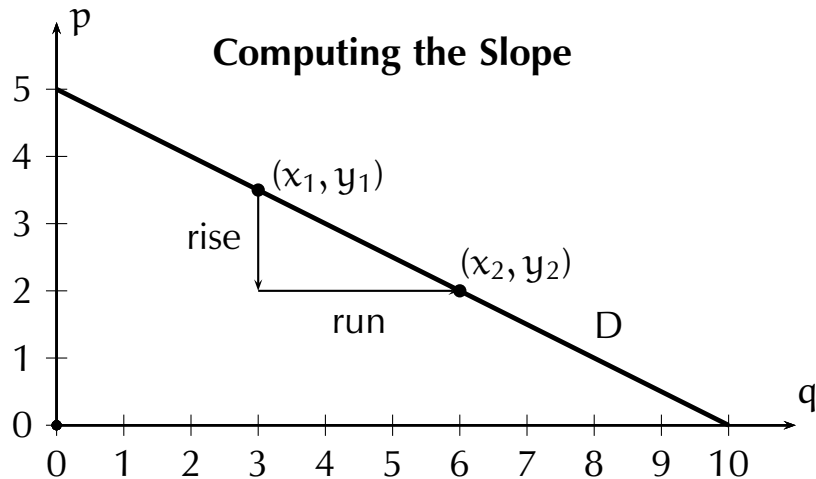


### 2.2.6 The Slope of a Straight Line

More generally, if two points on the line are  $(x_1, y_1)$  and  $(x_2, y_2)$ , then

$$\text{rise} = y_2 - y_1$$

$$\text{run} = x_2 - x_1.$$



It's sometimes quickest to use the endpoints of the demand curve since two of the coordinates are zero. Here they are  $(0, 5)$  and  $(10, 0)$  with rise  $-5$  and run  $10$ , again giving slope  $-5/10 = -1/2$ .

### 2.2.7 Demand and Inverse Demand

Now that we have the inverse demand function,  $p = 5 - \frac{1}{2}q$ , how do we find demand itself? For that, we must write  $q$  as a function of  $p$ . We must solve for  $q$  in terms of  $p$ .

Here's how it works. We start with the inverse demand function. We then move  $q$  to the left and  $p$  to the right. Then we multiply or divide so that we have  $q$  itself on the left, not  $3q$  or  $q/12$ .

We start by moving  $q$  to the left hand side of the equation. To do this, we add  $\frac{1}{2}q$  to both sides, leaving  $0q$  on the right hand side.

$$\begin{aligned}p &= 5 - \frac{1}{2}q \\p + \frac{1}{2}q &= 5 \\ \frac{1}{2}q &= 5 - p \\q &= 10 - 2p.\end{aligned}$$

In the third line we move  $p$  to the right hand side by subtracting  $p$  from both sides. Finally, to obtain the last line, we cleared the fraction on  $q$  by multiplying by 2. You'll notice that the slope ( $-2$ ) is the inverse of the slope of inverse demand ( $-\frac{1}{2}$ )

If you have demand, you can solve for  $p$  in terms of  $q$  to get inverse demand. E.g., if  $q = 30 - 3p$ , we can find that  $p = 10 - \frac{1}{3}q$ , or vice-versa. Again, the slopes of demand ( $-3$ ) and inverse demand ( $-\frac{1}{3}$ ) are inverses. This is true for all linear demand curves.

### 2.2.8 Factors that Affect Demand

The position of the demand curve can be changed by economic factors other than the price of the good. These factors include, but are not limited to:

1. **Prices of other goods**, especially prices of goods used with the original goods (complements) or goods that can be used instead of the original good (substitutes).
2. **Consumer preferences or tastes**. Consumers will sometimes revise their opinions of goods. Sometimes this is based on new information, such as certain foods being beneficial (or detrimental) to health, or learning that a product is more valuable than suspected. Sometimes it is nothing more than a change in fashion.
3. **Consumer income and wealth**.
4. **Number of consumers** (demographics). E.g., are younger consumers an increasing or decreasing share of the market?
5. **Expectations of future prices**.

The demand curve we've looked at has not included these other factors. One of the points of consumer theory is to give us a systematic way to include them.

### 2.2.9 Shifts in Demand

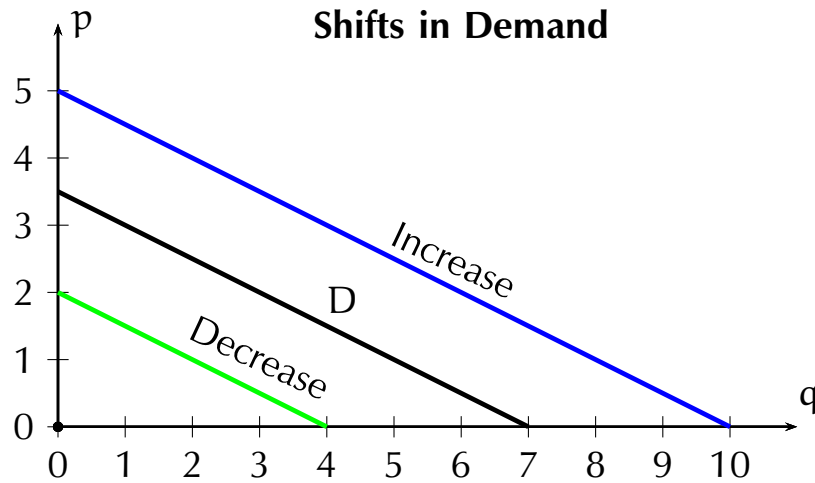
We focus on two types of shifts: increases and decreases.

**Demand increases** if the quantity demanded is greater at every price, or at least every price below the choke price. This means the demand curves shifts to the right.

**Demand decreases** if the quantity demanded is less at every price, or at least at every price below the choke price. This means that the demand shifts left.

### 2.2.10 Diagram for Shifts in Demand

Compared to the black demand curve  $D$ , demand has increased on the blue curve and decreased on the green curve.



Parallel shifts such as those above can be accomplished by changing the choke price. The three inverse demand functions, from top to bottom, are

$$p = 5 - \frac{1}{2}q,$$

$$p = 3.5 - \frac{1}{2}q,$$

$$p = 2 - \frac{1}{2}q.$$

## 2.3 Supply

**Supply** refers to the relation between price and the “quantity supplied”, the amount the seller wishes to sell at the current price.

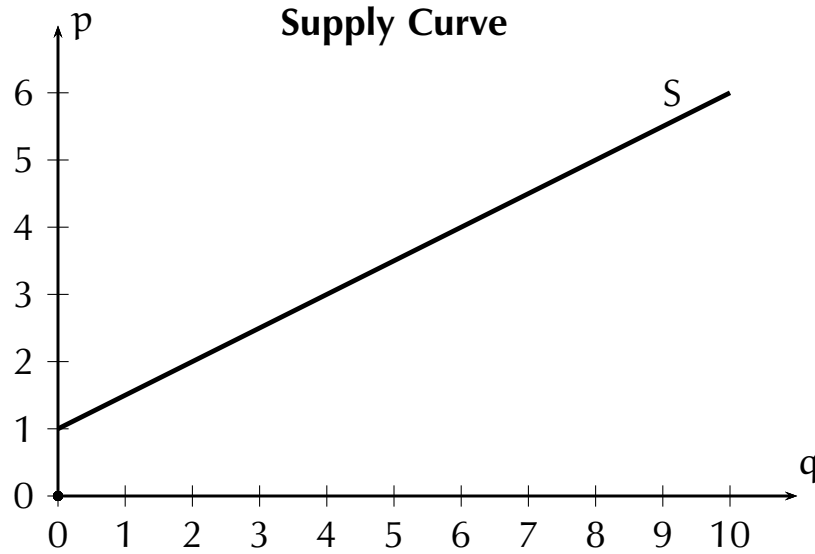
Supply is usually described in one of three equivalent ways:

1. **Supply Schedule:** A listing of prices and corresponding quantities
2. **Supply Curve:** A graph with prices on the vertical axis and quantities supplied on the horizontal axis.
3. **Supply Function:** A function  $q(p)$  that gives the quantity supplied  $q$  for each price  $p$ . Sometimes we prefer to use the inverse supply function  $p(q)$ , where price depends on quantity supplied.



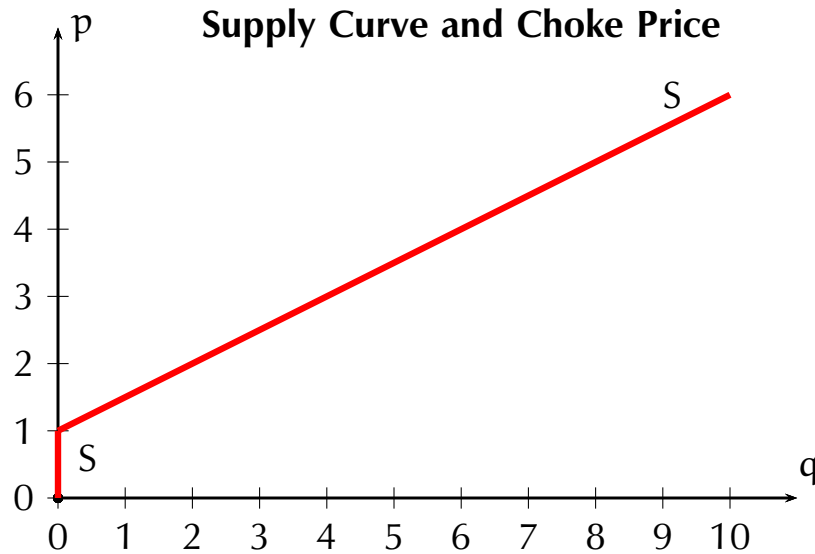
### 2.3.1 Law of Supply

Supply usually obeys the **Law of Supply**—quantity and prices are directly related. Equivalently, supply curves have a positive slope, as in the diagram below.

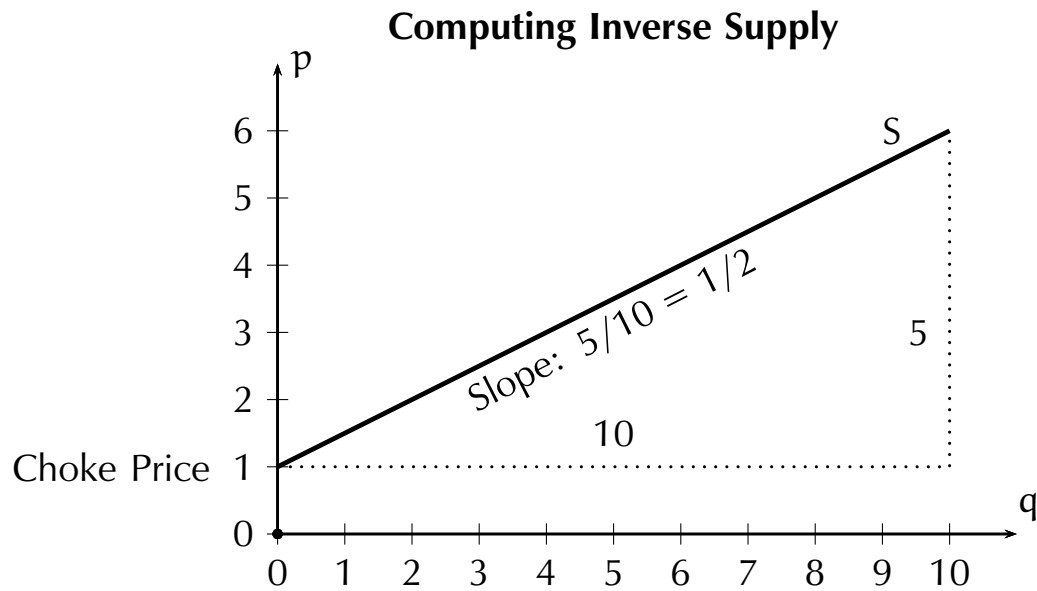


### 2.3.2 Interpreting the Supply Curve

Here  $p = 1$  is the **choke price**, meaning that quantity supplied is zero when the price is at or below \$1. As with demand, we don't usually draw the demand curve past the choke price. This time, I do.



### 2.3.3 Finding Inverse Supply from the Diagram



The vertical intercept is again the choke price, meaning that quantity supplied is zero when the price is at or below the choke price. The choke price in the diagram is 1, so  $p = 1 + bq$  where  $b$  is the slope.

For the slope, we use the points  $(0, 1)$  and  $(10, 6)$ , obtaining a rise of 5 and run of 10. It follows that the slope is  $5/10 = 1/2$  so the inverse supply equation is

$$p(q) = 1 + \frac{1}{2}q.$$

### 2.3.4 Factors that Affect Supply

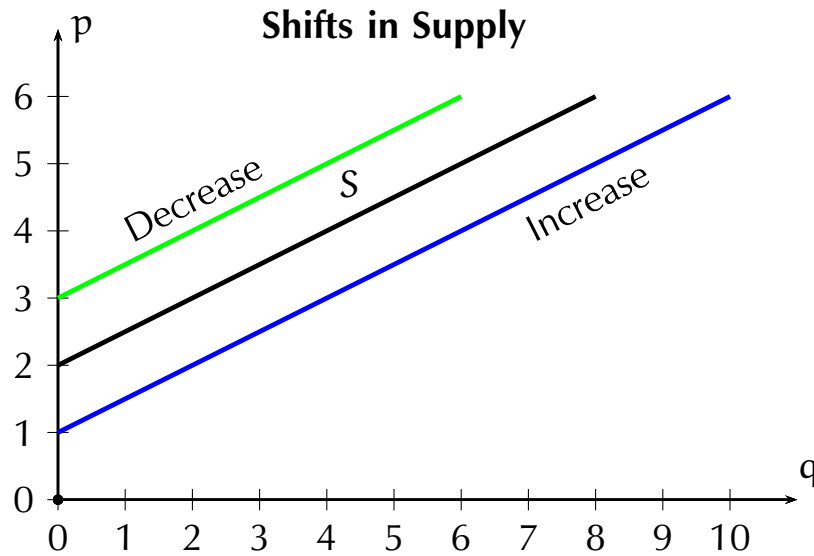
The position of the supply curve can be changed by economic factors other than the price of the good. These factors include, but are not limited to:

1. **Suppliers' costs** affect supply. Increases in the costs of inputs decrease supply. Decreases in costs increase supply. Here **inputs** means all goods and services involved in producing and/or selling the product.
2. **Number of sellers.**
3. **Seller's outside options.** These are affected by the prices of other goods you could produce instead, e.g., using your assembly line to produce more SUV's and fewer cars.
4. **Expectations of future prices.** If they're going up, it may be better to sell less now (reduce supply now) and more later (increase supply later) when the price is higher. Whether this makes sense depends on the storage cost.

### 2.3.5 Shifts in Supply

Like demand, supply can increase or decrease. Once again, an increase shifts the supply curve rightward and a decrease shifts it leftward.

Compared to the black supply curve  $S$ , supply has increased on the blue curve and decreased on the green curve.



Parallel shifts in supply can also be accomplished by changing the choke price. The three lines, from top to bottom, are  $p = 3 + \frac{1}{2}q$ ,  $p = 2 + \frac{1}{2}q$ , and  $p = 1 + \frac{1}{2}q$ .

## 2.4 Market Equilibrium

We can use the supply and demand curves to predict market outcomes. The key concept is **market equilibrium**, which defines an equilibrium price and quantity. The model shows how market prices and quantities change when supply and demand change.

It is possible to use data on supply and demand to estimate supply and demand curves. This is part of what econometrics is for. Those estimated curves can be used to estimate prices, quantities, and the effects of various policies.

In this class, we focus on the theory, not the empirics.

### 2.4.1 The Market Clears in Equilibrium

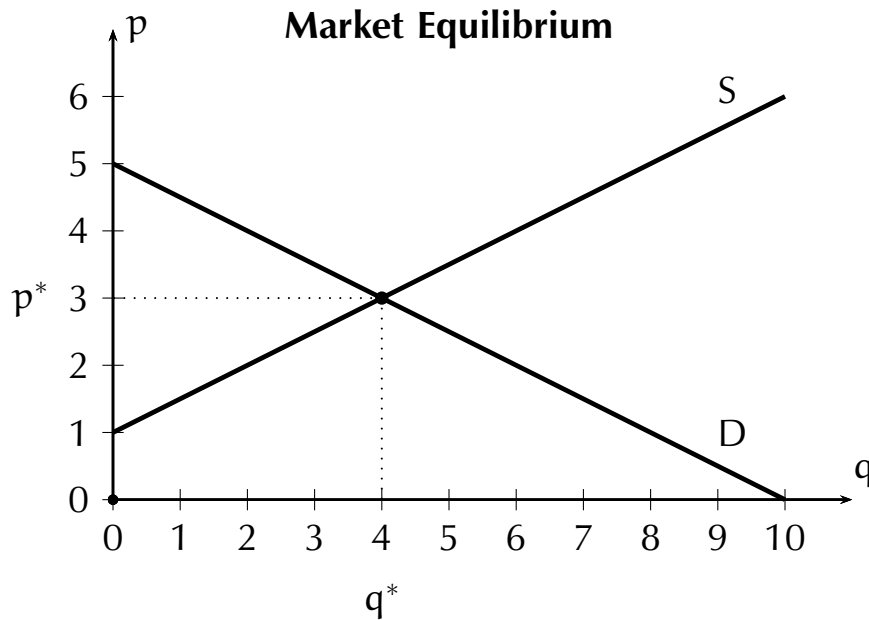
The market equilibrium usually requires that the **market clear**, that the quantity supplied equals the quantity demanded. At that price, for every unit any seller wants to sell, there is a buyer, and for every unit any buyer wants to buy, there is a seller.

The price where this happens is the **equilibrium price**  $p^*$ . Since the market clears, this also defines an **equilibrium quantity**  $q^*$  that is both the quantity supplied and the quantity demanded at  $p^*$ .

The equilibrium price coordinates the actions of buyers and sellers. It leads the buyers to attempt to buy  $q^*$  units, which is exactly the amount the price leads the sellers to supply. There are no unhappy buyers, who couldn't buy all they wanted at that price, and there are no unhappy sellers who couldn't sell all they wanted at that price.

### 2.4.2 Market Equilibrium Diagram

The intersection of the supply and demand curves gives us a price and quantity where the quantity is both the quantity demanded and quantity supplied. The intersection of the supply and demand curves the market price  $p^* = 3$  and market quantity  $q^* = 4$ .



The demand/supply model predicts both an equilibrium price and equilibrium quantity.



**2.4.3 Computing the Market Equilibrium: Quantity**

Both the equilibrium price and quantity  $p^*$  and  $q^*$  must simultaneously satisfy both the supply and demand equations.

$$p^* = 5 - \frac{1}{2}q^* \quad (\text{inverse demand})$$

$$p^* = 1 + \frac{1}{2}q^* \quad (\text{inverse supply}).$$

Putting them together yields:

$$1 + \frac{1}{2}q^* = p^* = 5 - \frac{1}{2}q^*.$$

Solving this, we find that the equilibrium quantity is  $q^* = 4$ .

**2.4.4 Computing the Market Equilibrium: Price**

We can now find  $p^*$  by substituting  $q^* = 4$  in either supply or demand.

$$p^* = 1 + 4/2 = 3 \quad (\text{supply})$$

$$p^* = 5 - 4/2 = 3 \quad (\text{demand})$$

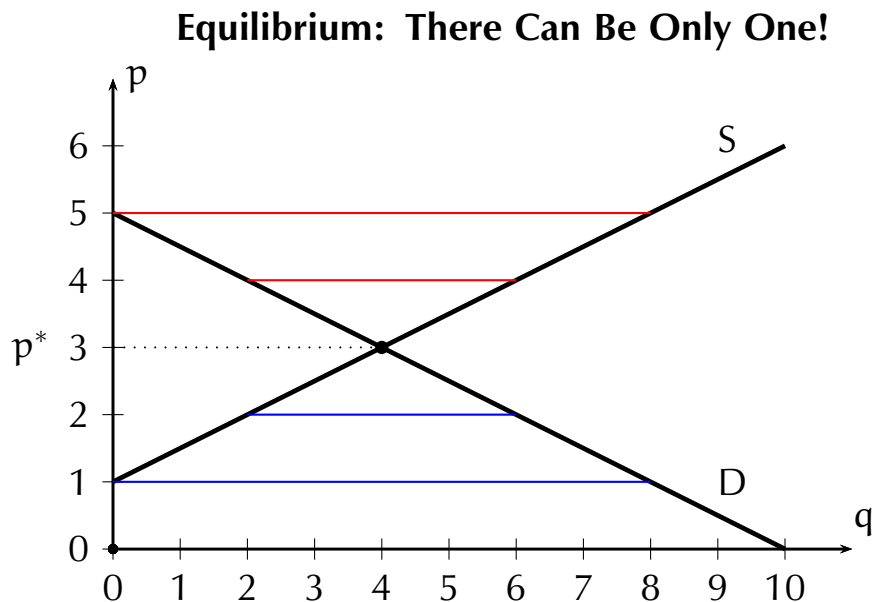
Both equations tell us that  $p^* = 3$ . You can use either equation to find  $p^*$ , and then use the other equation to check your work. If they don't match, you've made a mistake.

### 2.4.5 Can There be Two Equilibria?

No. There can be only one.

Since the demand curve slopes downward and supply upward, once we find an equilibrium price, the quantities supplied and demanded move farther and farther apart if we go up, or go down. There is at most one intersection.

The diagram illustrates how the gap between supply and demand grows both as  $p$  increases above  $p^*$  (red lines) and  $p$  decreases below  $p^*$  (blue lines).

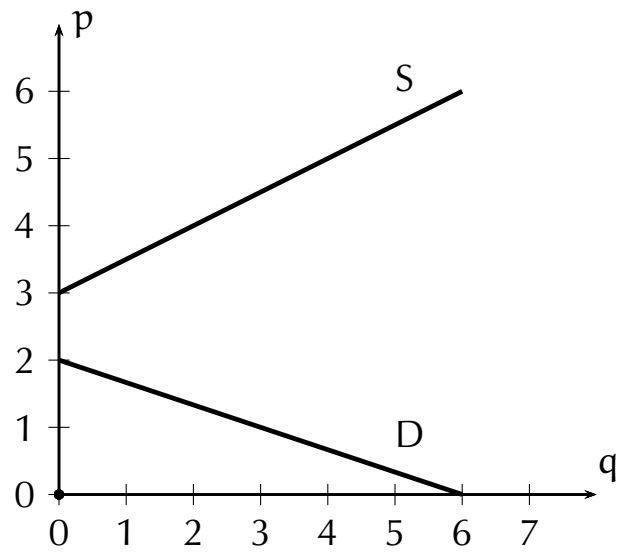


However, there is no guarantee that they intersect at all.

### 2.4.6 Supply Above Demand I

Do any prices clear the market? If so, what are they?

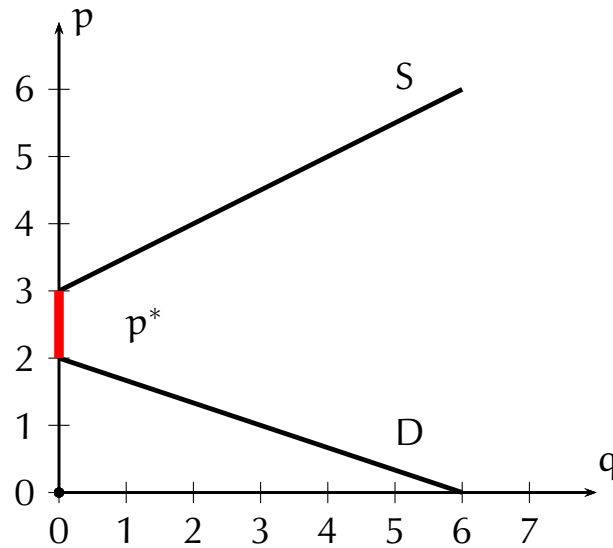
#### No Supply/Demand Intersection



### 2.4.7 Supply Above Demand II

Do any prices and quantities clear the market? If so, what are they?

#### No Supply/Demand Intersection

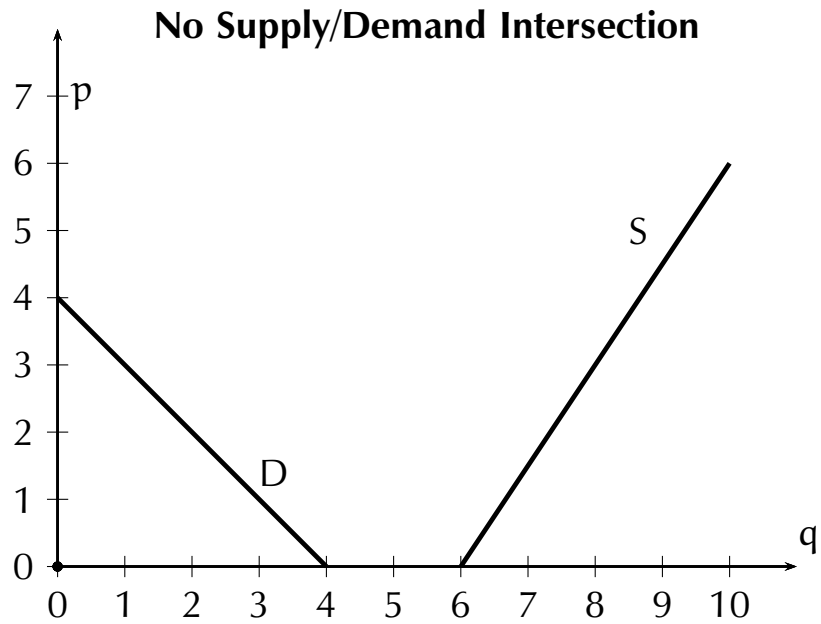


At any price between the choke prices, quantity supplied and quantity demanded are both zero—the market clears.

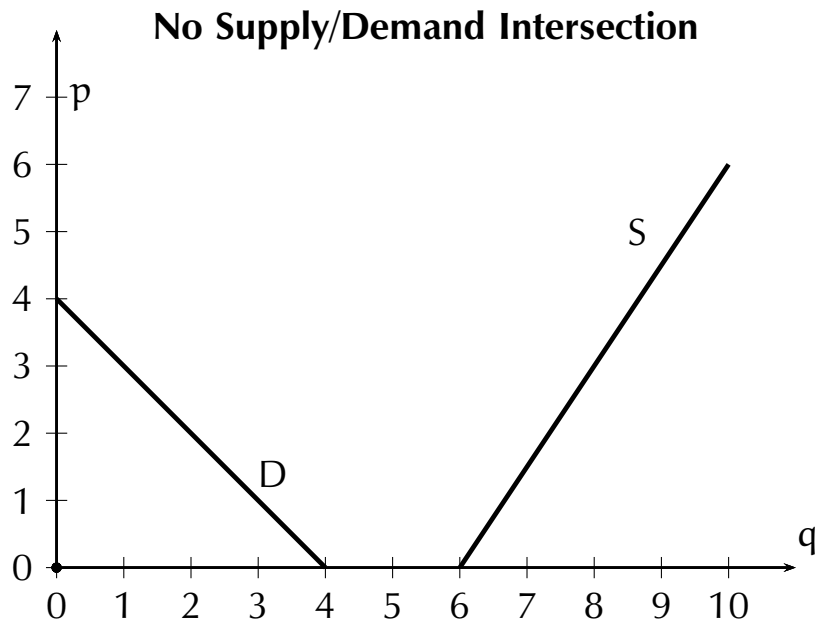
This diagram may apply to many goods that are usually available in the supermarket, but not available recently.

### 2.4.8 Supply Right of Demand I

Do any prices and quantities clear the market? If so, what are they?

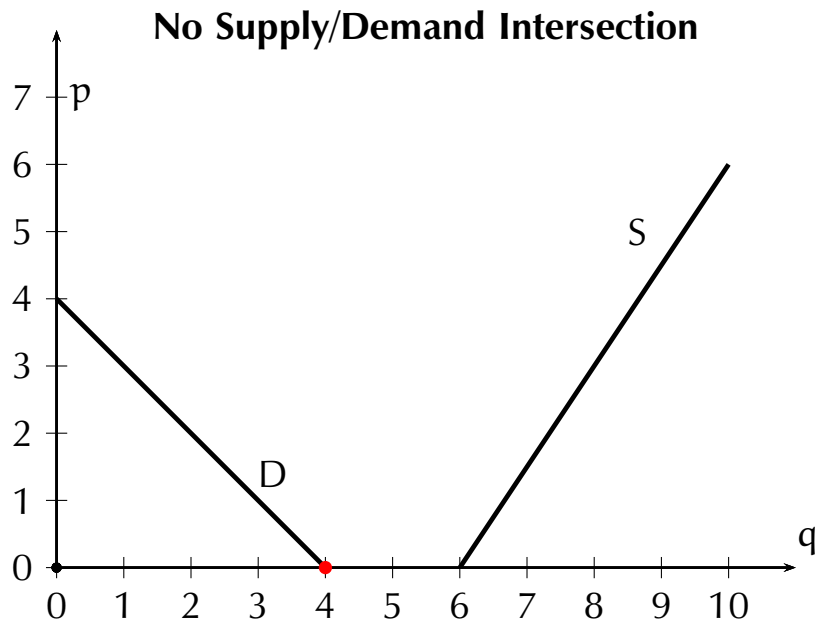


Notice that the supply curve does not have a choke price.

**2.4.9 Supply Right of Demand II**

In this case, there is no price that clears the market in our usual sense. The closest we can get is to set  $p = 0$ . Even then, there is still a gap between quantity supplied and quantity demanded. That gap is

$$q_s(0) - q_d(0) = 6 - 4 = 2.$$

**2.4.10 Supply Right of Demand III**

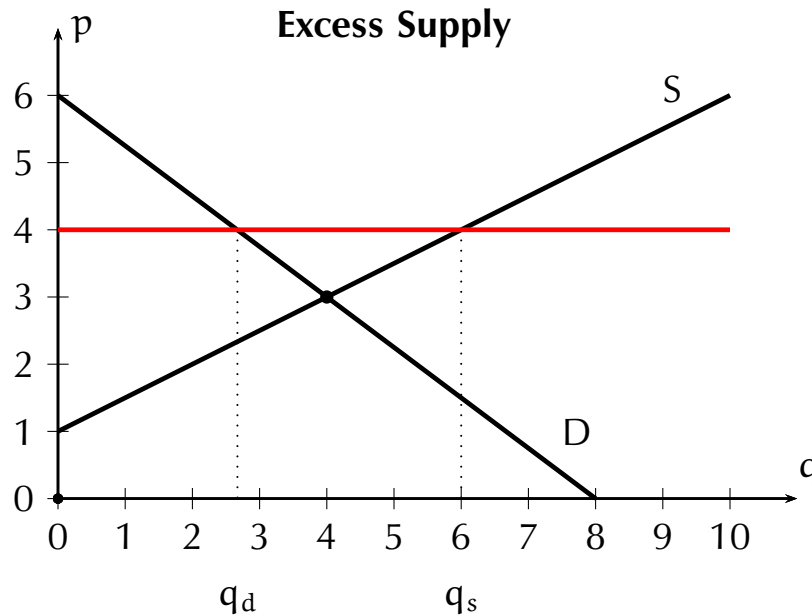
In situations like this, when the price cannot go lower, we expand the concept of equilibrium to allow quantity supplied to exceed quantity demanded. It works here because sellers cannot sell more than the 4 units the buyers are willing to buy, even though they wish to sell 6 units. They can only find buyers for 4, even when the price is zero.

The equilibrium is  $p^* = 0$ ,  $q^* = 4$ .



### 2.4.11 Price above Equilibrium—Excess Supply

Let's take a closer look at what happens when the price is above the equilibrium price. Let's try  $p = 4$ .



The equations here are  $p_d(q) = 6 - \frac{3}{4}q$  for demand and  $p_s(q) = 1 + \frac{1}{2}q$  for supply.

At  $p = 4$ ,  $q_s = 6$  and  $q_d = 2\frac{2}{3}$ . Since  $q_s > q_d$ , we say there is **excess supply** or a **surplus**.

### 2.4.12 Excess Supply

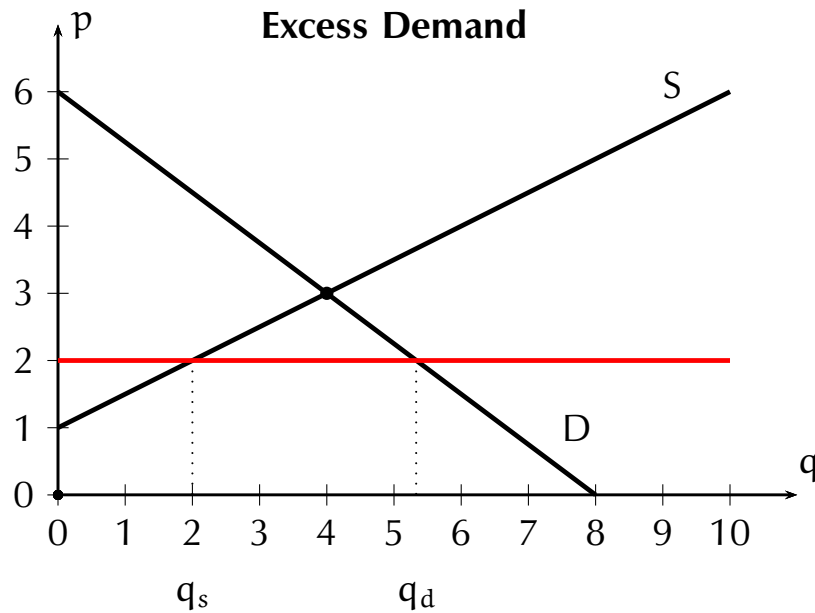
Excess supply has consequences. It means that sellers are supplying more than the buyers are willing to buy. Some would-be sellers can't sell. They will lose money.

**Price cuts:.** To avoid this, they cut their prices to find buyers. This forces the price downward (toward the equilibrium) whenever the price is too high. This doesn't have to be initiated by the sellers. Buyers could offer to take the unsold surplus off the seller's hands at a lower price. Either way the price is forced down.

**Not equilibrium:** Such prices cannot be called equilibrium prices because they are not at equilibrium. They are in the process of changing.

**2.4.13 Price below Equilibrium—Excess Demand**

This time we set the price below the equilibrium price at  $p = 2$ .



At  $p = 2$ ,  $q_s = 2$  and  $q_d = 5\frac{1}{3}$ . Since  $q_s < q_d$ , we say there is **excess demand** or a **shortage**.

### 2.4.14 Excess Demand

Excess demand has consequences. It means that sellers are supplying less than the buyers are willing to buy. Some would-be buyers can't buy all they want. Moreover, sellers could charge more (increasing their profits) while still being able to sell all they wish at that price.

**Price increases:.** To increase profits, sellers raise their prices, taking advantage of the excess demand. This forces the price upward (again, toward the equilibrium) whenever the price is too low. This doesn't have to be initiated by the sellers. Unsatisfied would-be buyers, who can't buy at the current price, could offer to pay a higher price to get the product. Either way the price is forced up.

**Not equilibrium:** As with prices that cause excess supply, prices causing excess demand cannot be called equilibrium prices. They are not at equilibrium, but are in the process of changing.

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**2.4.15 Market Equilibrium Again**

At market equilibrium, there is a seller for every buyer, and a buyer for every seller. The market clears, which ensures that there is no pressure for price to rise, or for price to fall. We expect to stay where it is—that's why we use the term "equilibrium".

*January 13, 2023*

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