An Introduction to Microeconomic Theory

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1 Introduction

This class is Economics 101 with more math. You will learn nothing new in this class, merely learn what you learned previously in greater depth, and—depending on your teacher for ECON 101—perhaps some new applications.

Sound boring? Well it's even worse than that. In the first section we will be deepening our understanding of consumer theory. Then we will turn our analysis upside down, call things by new names, and be analyzing producer theory.

The only thing we ever study in economics is the ramifications of two assumptions. Rationality (people aren't stupid) and equilibrium (people aren't surprised). This is the essential reason that we teach the same thing in ECON 101 and ECON 203 . This is the essential reason that consumer theory and producer theory are practically identical. The reason is that all our analysis is identical, it's just reworking these two themes. Once you understand and see this meta-structure in everything we do you will begin to really understand economics. Once you understand and see this meta-structure everywhere in the real world you will begin to understand the power of economics. This semester I hope to lead you to that insight.

A brief word on what material will not be covered in this class. This is not a math class, but I expect you to understand derivatives and optimization, and to catch on quickly to the Lagrange method. I will go over some of this when we need the material, but you should familiarize yourself with it and be certain you can handle it. Second, this is not ECON 101. If you have not taken that class you will be handicapped in this class. As I said most of the material in that class will be covered again, but I will do so assuming you know that material.

If you understand the math and introductory economics then you will be ready to benefit from what is perhaps my greatest strength as an economist: connecting the mathematics to your intuition. This is what I will be striving to achieve throughout this semester, and if you are adequately prepared for this class I expect you will benefit from this approach.

Let me make one thing clear at this point. Economics is not Mathematics. Mathematics is the *language* of economics. Like knowing English to do well at Bilkent you must understand Mathematics to do well in Economics. But, like English, Mathematics is meaningless on it's own within Economics. Economics is about intuition, and explaining that intuition, not math.

1.1 Some Definitions of "Microeconomics"

So what is economics about? Well here I will be satisfied with trying to define Microeconomics, a hard enough task. Let me first give you a couple of "traditional" definitions. Both of these definitions do not fit all of Microeconomics as it is currently analyzed, they fit better into a "traditional" market, where you have buyers and sellers and some sort of marketplace for them to interact in. Like a traditional bazaar, or Bilkent Center—more abstractly "malls in Ankara." Here is one definition from Pindyck and Rubinfeld's Intermediate Microeconomics textbook.

Definition 1 *Microeconomics deals with the behavior of individual economic units—consumers, firms, and investors—as well as the markets that these units comprise.*

Or another way of putting it:

Definition 2 *Microeconomic Theory concerns the behavior of individuals and the aggregation of their actions in markets.*

You can get a fairly accurate "box" from these definitions. One can easily figure out what is and is not Microeconomics. Essentially Microeconomics starts with the individual and goes up from there. We are interested in their buying and selling behavior. Both of these definitions are fairly sharply edged, a good thing in a definition but sometimes too restrictive. To give an example of a problem in this definition, those consumers, are they individuals or families? Does this affect your analysis? What about gift giving? Is that outside of the economic realm? An employer's relationship with his employee, is that a market? Is it outside of economic analysis? What about political campaigns? Aren't they trying to "sell" something, and aren't we deciding which candidate we will "buy"? Where in society does the "market" stop and the "society" begin?

Thus I present a more general definition, one with less clear boundaries. This definition is more about methodology, which is how I define economics. I have read papers on every subject under the sun—from the economics of altruism to the economics of lawsuits—and what binds them together is a methodology. This methodology better fits the following definition:

Definition 3 *"Microeconomic Theory is about the decision making and interacting of rational individuals."*

Uhh ohh, there's that word again. "Rational." It's going to be a very important word in your life for the next few months, and hopefully for ever after. It's a big concept. One of the two big ones in economics.

1.2 The Two Axioms of Economics

So that leads us to our second subject, what are these fundamental assumptions and (more importantly) why do we make them. The fundamental axioms

(axioms—assumptions that should be questioned with great care)[1] are *rationality* and *equilibrium*.

Rationality is by far the most important concept in the Economic methodology, and one of the most important contributions of Economics to the study of human behavior. It is so important that I will give three definitions, or two definitions and a motivation.

Definition 4 (Motivational) *Never assume people are stupid. Especially never assume that the people you are analyzing are less intelligent than you are. They are doing the best for themselves they can and probably have at least as much information as you do about their situation.*

This is the most important "definition" of rationality. A great example is Slavery in the United States. Abraham Lincoln—President during the civil war that ended slavery—said that slavery was an "antiquated, old fashioned" method of production that was "sure to collapse under it's own weight" if the North did not—magnanimously—intervene and outlaw it. This belief was certainly politically desirable at the time, and many historians continue to hold to this opinion, but in general it has been proven absolutely false.

The thesis that slavery was rational behavior by enlightened profit maximizers was the central theme of Fogel and Engermann's "Time on the Cross." While many economists would say that this book was overly kind to the slave owners and that some of their findings were based on bad analysis their central claims have held up. Slave owners were rational profit maximizers, perhaps what they were doing was morally repugnant but economically it was rational, optimizing behavior.

And sometimes the rational profit maximizer can do the best thing for themselves even when the best scientific knowledge—at the time and today—could not tell them what to do. An example of this is slave nutrition, a careful study by Richard Steckel[2] showed that slave owners starved slave children until they were twelve and then began feeding them better than contemporary free Americans. He based his analysis on slave height and mortality rates—good indicators of overall nutrition—and he found that before the age of twelve slaves were short and had high death rates. After the age of twelve their height shot up until they were taller than the average American—thus better fed.

This fits very well with rational profit maximizing behavior because until a slave was about 12 they were not productive, and by following this scheme the slaves' productivity was not hampered. By feeding them excessive amounts of

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[1]When you look up "axiom" in the Mirriam Webster on line dictionary (http://www.m-w.com/home.htm) you find the following three definitions:

1 : a maxim widely accepted on its intrinsic merit.

2 : a statement accepted as true as the basis for argument or inference.

3 : an established rule or principle or a self-evident truth.

However a scientist should never accept a "self evident" truth. To a scientist something that is accepted on it's intrinsic merit must be questioned carefully. It will, after all, be a fundamental mistake if it is wrong.

[2]Steckel, Richard. (1986) "A Peculiar Population: The Nutrition, Health, and Mortality of American Slaves from Childhood to Maturity."

meat the slave owners were more than able to overcome the potential problem they caused by starving the children. The surprising thing about this finding is that modern nutritional science could not predict that this strategy would work—any nutritionist who suggested starving children until they were twelve would be shot. The slave owners themselves were not aware that they were doing this. They thought the children were healthy. "Look at their shiny skin and fat, round bellies," they would say to visitors concerned about slave health. Modern day nutritionists know that these are both signs of malnutrition.

So what is the lesson? Not only are people rational but they can do things that seem beyond their capability. It is only a fool who assumes otherwise.

The next two definitions are more important and less controversial, in fact many economists are not clear that there are two definitions. These two definitions are the *positive* and the *normative* definitions of rationality. A *positive* statement—or definition—merely tries to explain reality. It makes no moral or intellectual judgement, it merely says what is. The positive definition of rationality is therefore the weakest one:

Definition 5 (Positive) *People do not choose inferior options.*

This seems like a very mild definition. Notice that what we are essentially assuming is optimizing behavior. It has been proven that soap bubbles are optimal, they cover the most space with the minimal amount of material. As well all animals try to get the maximum return for the minimal effort. (Except for exercising humans, which explains why I find this behavior so strange.) The point is that optimizing is natural, and a fundamental assumption about behavior in almost every Science—so why not human behavior?

Alternatively a *normative* statement has something to say to reality. It has either a moral or intellectual judgement to make. It says "if you don't behave in this manner then you must be making a mistake." Almost every policy analysis makes normative statements, we will be making many in this class, but a normative statement can be false. This definition might seem a lot like the last one:

Definition 6 (Normative) *People always make the best decision possible. They always do what seems best.*

If you are looking back and forth from the Normative to the Positive definition and trying to figure out what the difference is you are not alone. It is mysterious until you look closely. In the first definition do I say what people will choose? Or that they can even make a choice? In the second I do, this definition is also equivalent to saying:

Definition 7 (Normative II) *Every person can:*

1. *Compare all options (preferences are complete)*

2. *Always make decisions (preferences are transitive)*

The technical terms in the parentheses are formal axioms of preferences, look at the handout on the axioms of choice for more discussion. Notice what this assumption does not mean, it does not mean that everyone will choose the same thing or that people can't make mistakes.

"Rationality" is not the same as "preferences." For example Shia Muslims sometimes ritually flagellate themselves as part of a religious observance. That behavior is rational, given their preferences—or as they are normally called in this case *beliefs*. Personally I won't do it because I do not share their beliefs, and my behavior is rational as well.

When "people make mistakes" an Economist says, "they lacked important information when they made their choice." The difference is that in the second case what we are saying is that they had bad information, or wrong beliefs. Let me give a personal example of this. I was down in Antalya looking at summer houses and had found a beautiful one. It had a view of the Mediterranean you wouldn't believe and was reasonably priced. I and my wife decided to buy it. This was a rational choice, it was a beautiful house for a reasonable price in a great location. However there were a few cracks in the building and just to figure out how much it would cost to fix we took some pictures and showed them to a friend of ours in the construction business. We found out that it might cost forty to fifty thousand dollars to fix up the house, and we didn't buy it. That was a rational choice as well. Either choice would have been rational, it is fortunate for us that we took some pictures and had a friend in the construction business.

Rational behavior depends on preferences and information. People with different preferences or information can do very different things, but they are all rational.

Equilibrium is the second general assumption we make in economics. While it is less easily defensible than rationality it is necessary for us to be able to do analysis.

Definition 8 *Equilibrium means no one is surprised, or the world is in balance. They may not know exactly what will happen, but at least they have a reasonable idea how likely the possible outcomes are.*

This is what we mean when we say supply meets demand. There is no shortage or excess supply because then the world would be out of balance, and some people would either offer to sell their goods for less or buy for more. Understanding this concept is more complex when there is uncertainty involved, so let me give a few examples.

Consider the stock market and the government announcements about economic policy and economic statistics like the GDP and unemployment. The stock market usually reacts to such information, but sometimes in the opposite direction of what you would expect. The government says the GDP grew 5%, and the market falls. Unemployment is high and the market rises. Why? Is it irrational animal spirits? No, it's merely the effect of expectations. The people invested in the stock market have expectations of the GDP and Unemployment,

if these expectations are overly optimistic or pessimistic (respectively) you can see the market compensating by going the opposite direction. This is proof positive that while there is uncertainty the investors try to predict this uncertain outcome and compensate for it. Sometimes the expectations are too pessimistic or optimistic but a lot of the time they are practically dead on. Investors don't know what happens but on average reports do not take them by surprise.

Another example is penalty kicks in football. There you have one player trying to get the ball past the goalie. Obviously if the goalie knows where the player will shoot then he will stop the ball. The player has to randomize over where he will shoot the ball, and usually he is successful and scores. This is still equilibrium, the goalie expects the player to randomize and he does.

This assumption is less defensible than rationality, it is clear that a lot of situations in the world can not really be described as being in equilibrium. However the assumption is justified despite this, because we don't know enough.

It is clear that there is out of equilibrium behavior in the world, but it is also clear that a lot of the world is in equilibrium. Should we analyze out of equilibrium behavior or equilibrium? Out of equilibrium behavior must necessarily be more complex, more complicated, more affected by things that we are not certain about. It is better to analyze the simpler—and perhaps commoner—phenomena of equilibrium behavior. Once we understand equilibrium precisely enough then we can proceed to analyze things that are not in equilibrium.

2 Four Great Insights of Rationality.

Most of the insights that you can use in everyday life are based only on the axiom of Rationality. This is the axiom in the positive form, i.e. people with weird preferences could disagree about some of these insights, but they are useful insights that can help you in everyday life.

Many of these insights I still have to teach to graduate students, the implications of these insights are so far reaching that they still haven't grasped them all. The sooner you start trying to understand and apply them the better you'll be as an Economist, Businessman, or Manager.

1. It's the margin, not the average.

   This is by far the most basic and the deepest insight in Economics. The "margin" in general means the first derivative of the objective function. So many people when they want to decide whether or not to expand some project want to know "are we making a profit." But this is the wrong question. Profit being greater than zero is the same thing as average profit being greater than zero. To maximize your profits you should expand only if the *change* in profits is positive, or the *marginal* profit.

   Let me give you an example that some graduate students still fail to grasp. Market price has no relation to the value of the good. Instead the Market Price is set by the Marginal Value or Marginal Cost. This was the essence of the solution to Adam Smith's Diamond-Water Paradox. Adam Smith

is often hailed as the first Economist, and the Diamond-Water Paradox was one of his greatest insights.

Relatively speaking, I think we can all agree that Diamonds are worth much less in our life than Water. Without water I would have no life, without diamonds I simply wouldn't have one minor luxury. And yet the price of diamonds is so much higher than the price of water. Why is this? Because price is set by the margin, and in this case the marginal cost of extracting a diamond is very high, while the marginal cost of water is practically zero.

Another example was given to me by a friend who was consulting the Mexican government. Mexico is a major exporter of oil, and the cost of production is very low. Thus the Mexican government wondered why the price of oil in Mexico was so high when the average cost of production was so low. My friends answer? Where does the marginal barrel of oil go? Of course it goes to the world market. So what sets the price of oil? The marginal barrel.

2. It's all relative.

I'd like to say we thought of this first. Albert Einstein just stole it from us and got famous off of it. But unfortunately that's not true, and we mean something quite different when we say it. What we mean is that no price all by itself means anything, only when you discuss one price relative to another do prices become meaningful.

Turkish people should be good at understanding this due to the hyper-inflation this country has experienced. I easily impressed my nephew in the US by bringing him a million lira note. "You are now a millionaire," I said. He was so awed. Should he have been?

To give you another example, say that I offered you a job for $15,000 (fifteen thousand) a year (or 1250 a month)? In Turkey since housing and food are so cheap you would probably be pretty happy. But in the US rent alone can easily cost 750 a month, and food is much more expensive as well, so you would be struggling. And how excited would you be if I offered you a job for $120,000 a year ($10 thousand a month)? In the US or Turkey I think you'd be pretty excited, but this is how much my brother-in-law paid for rent in Hong Kong. It's all relative, salary isn't meaningful until you tell me the cost of living.

As another example how far away is Istanbul? I know, somebody will say "450 kilometers." This is true, but meaningless. What do I mean? Well say that there was no good road between the two cities, then the top speed you could do would probably be about 45 kilometers per hour. Then Istanbul would be ten to twenty hours away. And what if you didn't own a car? By horse that distance would take at least four days, and probably more like ten. As it is Istanbul is about four, four and a half hours away. But it doesn't even stop then. If I am unemployed—or

retired—my time isn't worth very much and I might use the horse if I could do it more cheaply. It's all relative, distance doesn't matter, it's distance divided by speed, and I also need to think about the value of my time.

3. "Sunk Costs are sunk costs" is an insight that seems completely meaningless, but it is a saying that economists use a lot. A "sunk cost" is a non-recoverable expense. Like a concert ticket that you've already paid for. The concert sponsors won't give you your money back if you don't show up. You've bought it, and so you've got it. This insight is also known as the "sunk cost fallacy," the fallacy (error) is to consider sunk costs at all. Think about it, you've bought the ticket so you won't get that money back. You might regret not getting what you pay for but it shouldn't affect your decision. In plain English this insight should read "ignore sunk costs." Another example, if you are building something the cost of laying foundations, the payment to architects for the plans they make, inspections by engineers, etcetera, are all sunk costs. You can't get them back if you stop building. On the other hand furniture you have bought for the office is not a sunk cost, because you can always resell it and get most of the cost back.

If you are building a bridge then the entire structure is a sunk cost, nobody wants to buy a half built bridge (that isn't worth finishing.) Let me give an example using the latter case, one which frequently happens in reality. Say you are thinking about building a bridge across the Bosphorus in Istanbul (and have managed to solve all of the political problems.) You think the bridge will be worth $10 million dollars in terms of reduced travel costs to the Istanbulular and the expected cost is $8 million. What to do? You build, because the marginal benefit is greater than the marginal cost

$$\$10 > \$8$$

But halfway through (after spending $4 million) you find out that the land underneath the Bosphorus where you want to build is extremely soft, and has a lot of cracks in the bedrock. This means that you have to re-dig all of your pylons, and you have to dig them deeper so you will almost loose everything you already built. The expected cost of completing the project is still $8 million. What do you do? Well the naive answer would be not to build. Because the total cost—$4 + $8 = $12—is greater than the benefit.

But you have to think things through more carefully than that. What will happen if you shut down? You will still loose $4 million. So your comparison should be:

$$\text{Complete Bridge} \overset{?}{\lessgtr} \text{Shutdown}$$
$$\$10 - \$8 - \$4 \overset{?}{\lessgtr} -\$4$$

and the $4 million cancels since it's on both sides of the equation. Why? Because it's a sunk cost. Everything you've spent on the bridge is lost money. Whether you complete it or not you will never get it back. So you ignore it, what you should check is:

$$\$10 - \$8 \overset{?}{\lessgtr} 0$$

and since $10 > $8—like it was in the first place—you should continue building.

This is why you see so few buildings that are partially built. It's not because there aren't cost overruns—there frequently are—but because when there are cost overruns since the project has been partially completed usually the expected cost to complete the building is less than the benefit. In Turkey you will find more partially completed buildings than in many other countries since the hyper-inflation has cut into the lending market, but even here you will find very few.

This is also why it's generally not a good idea to get out of line once you enter it. All of the time you have spent in the line is a sunk cost, not -recoverable. Thus all that's important is the time remaining until you get to the cashier. Therefore once you've been in a line for a while even if you realize the cashier is slow it's not worth switching. You might switch if you've only been in line five minutes, but not if you've been waiting a half hour.

4. "It's opportunity cost, not accounting cost." is another insight that is meaningless unless you know what the words mean. "Opportunity cost" is the cost of a project minus the cost of the second best project. For example if I offer you a job for $48,000 a year ($4000 a month) how excited would you be? Well that all depends on your best other option. If someone else is offering you $60,000 a year ($5000 a month) they you won't be too excited will you? So the amount I'm offering you doesn't really make you excited. What makes you excited is how much I offer you relative to your best outside option. Or the Opportunity Benefit (the direct benefit minus the benefit of the outside option.

Another example can be drawn from Northwestern University's choice of where to put their law school. The main campus is in a suburb of Chicago but the University owned some land in the heart of downtown Chicago. Do we locate the Law school downtown or in the suburb? A naive argument (and one that was put forward) was that the land downtown would be free, while land in the suburb would cost hundreds of thousands of dollars. But this argument is wrong. How much would the land downtown be if Northwestern sold it? It would be worth millions of dollars. So the opportunity cost of locating downtown is millions of dollars. Based on opportunity cost the suburb would be cheaper, even though they would have to buy land.

3   On Models—Supply and Demand.

The famed "Lucas Critique" in Macroeconomics is equally important in Microeconomics, or any science. To paraphrase a part of his argument: Any model, every model, must be wrong by definition. Why? Because the duty of a model is not to include and to fit every observed fact in reality. Instead it is to boil down reality to a few simple critical facts that have the ability to explain a great deal.

A good example of a model is a map. Have you ever tried to drive around Turkey with a map? It's hard isn't it? Why? Because the map does not include all the twists and turns in the roads. It doesn't show how hard it is to exit from this street to that street. It doesn't even usually have the one way streets marked. And there are always lots of small roads that aren't marked on the map, what do you do when you come across one of them? Especially if you were counting streets before making that right hand turn—was that a street or not?

But does this make the map bad? Imagine a map with all of that information included on it. Yep, it would have to be exactly the size of the city you're driving through. Now wouldn't that be a great map? Have you ever noticed how they always have lots of different maps on sale? Some of them larger—with more small roads and other markings—and some of them are smaller, and easier to see a good way to get from here to there. Are the smaller ones worse? The larger ones? Really depends on what you want to do with it doesn't it?

So what are the essential elements we want to study in a market for, say, apartments. Oh wow, there are so many important things to consider. How many bedrooms, location, does it have a view, how is the public transport, are there good roads near by, is there an elevator, are the walls thick, are the bathroom fixtures nice, is there a lot of light, are the neighbors friendly, is there a nice balcony, are their gardens around the apartment, are those gardens nice, how is the kapici, how is the maintenance, is the water included in the rent, is the heat included, are there carpets or wood floors, marble counters, tile floors in the bathroom and kitchen, lots of electric sockets, nice light fixtures, a bathtub, a fireplace, a barbecue on the balcony, and gosh my list has just started!

How many of you read all the way through that paragraph? I hope you didn't. It's obvious that nobody would be interested in a model that included all of that detail. It wouldn't be a model, and it would have practically nothing of interest to say. Let's see if we can agree on the most important characteristics about the market for apartments. Would anyone disagree with price (rent) and quantity sold? I think we can see that these are the first things we should discuss in our model. Obviously we have to figure out a way to deal with different size apartments, but for now let's just assume they are all the same size. What are we going to do about all of the other characteristics? Now we get into the most fundamental assumptions in any model. We will assume that all other things are held constant, or *Ceteris Paribus*. We will assume that if the price or quantity of apartments rented in Ankara changes then the other characteristics of these apartments will not. Renting more apartments does not

mean that the neighbors will be less friendly, that there will be fewer balconies, or marble counters, etcetera.

Now let's try to build a model. Say that each landlord only has one apartment to rent to make things even easier. Then a model of the market could be:

Demanders			Suppliers	
ID	Value		ID	Cost
A	3		a	6
B	11		b	4
C	1		c	1
D	7		d	2
E	4		e	10

Here the "Value" is the value of the apartment to the demander, and the "Cost" is the amount the supplier will have to pay in order to be able to rent the apartment. In this market there will be a market price for apartments, and anyone who wants to buy or sell at that price can do it. So what will this be? Well a good place to start is at the top, so how about a price of 3? The demanders will be A, B, D, and E, the suppliers will be c and d. Oh no, the number of demanders is greater than the number of suppliers or we have a *shortage*, let's start over. How about with 6? Then a,b,c and d will supply apartments, and B and D will buy. We now have a *surplus* of apartments, failure again...

This is not working. Lets use a little more analysis. Notice that all we care about in each case is the *number* of units supplied and demanded. This brings us to the basic model of supply and demand.

| Demanders			Suppliers	
Q_d	Price		Q_s	Price
5	0-1		0	0-1
4	1-3		1	1-2
3	3-4		2	2-4
2	4-7		3	4-6
1	7-11		4	6-10
0	11+		5	10+

now it's immediate that the equilibrium price is 4 and quantity is 3. This can be made even clearer if we graph this situation.

Unfortunately we have a slight problem at this point. When Marshall was originally constructing this model (around the beginning of the twentieth century) economics was not as formal of a mathematical discipline as it is today. In mathematics the independent variable—price in this case—is written on the horizontal axis. The value of the demand or supply function—which is quantity—is on the vertical axis.

Marshall got it wrong. I like to call this "Marshall's Mistake." Because of this a *flat* supply curve has a *high* slope, a vertical supply curve has a low slope. You don't think that is annoying? Wait until a little later in the semester,

sooner or later you'll freak out and tell me that I've done it wrong. I won't have, you'll just be being annoyed by Marshall's Mistake. Oh, and by the way, if after more than a hundred years anything that you have done has withstood the test of time—even with small mistakes—I will be very impressed. Marshall did great things for the study of Microeconomics, he was in many ways the father of classical microeconomics. He only made one, small, mistake—just an annoying one.

Thus, due to Marshall's Mistake, the Supply and Demand curve in this market can be represented in the following picture.
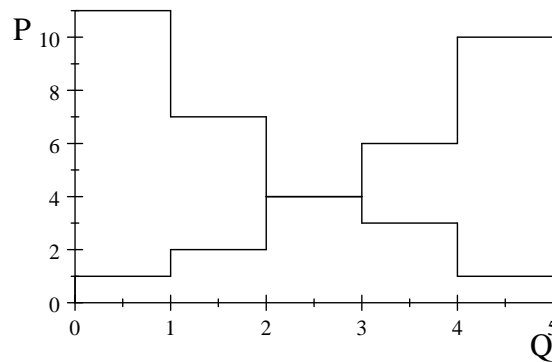
from this picture we can immediately see that the equilibrium price is 4 and quantity is 3. We can also see why this is the equilibrium. Remember equilibrium means "nobody is surprised." Consider having another price, say 6. At that price only 2 units will be demanded and 4 units will be supplied. This would mean that only two units would be sold at a price of 6 and we would have a *surplus* supply of two. What is a reasonable producer to do in this case? Generally he would cut the price of the extra units down to their marginal cost and try to sell them off. In this case he would be able to sell the one priced at 4. OK, we've gotten rid of our surplus, but now the two demanders who paid 6 will be surprised, and try to get out of their contract. Likewise if we started with a price of 3, there would be excess demand or a *shortage*, leading to the sale of one unit at a price of 4, leading to discontent on the part of those who sold at a lower price.