Exercises, Chapter 1
Economics and the Principles of Choice

Chapter 1 is more *about* economics than an introduction to its tools and techniques, but a few of the chapter's concepts can be reinforced with exercises. We will consider them after a short refresher about *graphs.*

Graphs are actually not necessary in economics. Ludwig von Mises's *Human Action* (Chicago: Regnery, 1966) uses no graphs at all, and in the course of nine hundred pages Mises uses only two simple equations. Graphs and math were not widely used in economics until about the turn of the 20th century, at which point economics was itself well over a hundred years old! John Stuart Mill's thousand-page 1848 classic *Principles of Political Economy,* the dominant economics textbook for about fifty years, has no graphs. But graphs serve the useful function of providing rudimentary pictures of abstract concepts, serving the same purpose as an example of an abstract principle, and we all know how much a concrete example helps us to grasp a principle.

Every graph shows a relationship between at least two variables, usually a quantitative (numerical) relationship. Three-dimensional graphs show relationships among three variables, four among four, etc. We will use mostly two-dimensional graphs in this course. Here's one, a hypothetical relationship between the number of hours the typical student studies (including time attending class) each week and his likely grade in the course. (These numbers are chosen for simplicity, not realism; a more realistic relationship will be offered later.)

Hours a student studies economics, per week	Probable grade in this course (out of 100)
0	0
1	10
2	20
3	30
4	40
5	50
6	60
7	70
8	80

Each number of hours is matched or paired up with a corresponding expected grade: (0,30), (1,40), (2,50). To obtain a visual image or graph of these data, we construct axes, with "hours of study, per week" on the horizontal axis and "expected grade" on the vertical axis.

When we relate grade to study, we are relying on a theory of academic achievement, a theory about CAUSE and EFFECT. In this particular case, of course, the study time is the cause, and the grade the effect. One normally identifies the CAUSAL variable (study time, here) as the "independent variable," because we can imagine whatever we want about it. (Of course the number of hours one studies itself has causes, and it is an effect of them, but we have to start somewhere.) Independent (causal) variables are normally identified with the HORIZONTAL axis in a two-dimensional graph. It's also sometimes called the "X-axis" or the abscissa. The variable that we believe to be the EFFECT in the relationship we're depicting (expected grade, here) is called the "dependent variable," because it depends on, or is determined by, the independent variable. It is placed on the VERTICAL axis in our two-dimensional graphs, which is also sometimes called the "Y-axis" or ordinate.

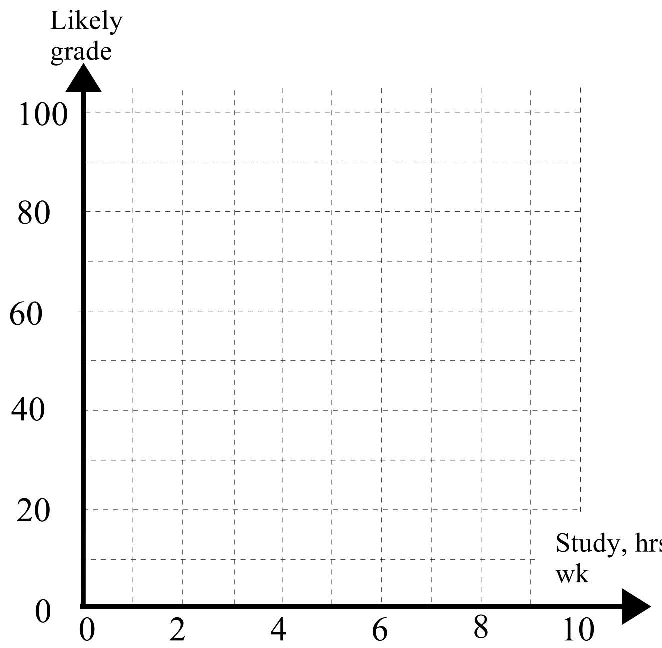


Figure 1: Grade and study time

1a) Identify the pairs of data with points on this set of axes: (0 hrs, 0), (1 hr, 10), (2 hrs, 20), etc. Use small CIRCLES to identify your data points.

1b) Now, DRAW A LINE that connects those points; it will extend upward and to the right toward the upper right corner of the axes. This graph, your first of many in this course, provides a simple visual sense of this relationship between study time (the cause, or independent variable) and expected grade (the effect, or dependent variable).

1c) What does this graph suggest would probably be your grade if you studied 6½ hours per week?

What about 2½ hours (doing nothing except attending class)?

What you've just done is called INTERPOLATING, inferring something about values of variables that lie *between* two that you know. It's a little risky, because there might be some quirk about studying that makes your grade shoot up if you study exactly 6.5 hours and we don't know that, but interpolation is often very helpful.

1d) According to this graph, what happens to your expected grade if you were to INCREASE your weekly study time?

What happens to your grade if you DECREASE your study time?

When the dependent variable (expected grade) changes in the same direction as does the independent variable (study time), the relationship between the two is said to be DIRECT. If they changed in opposite directions, an example of which we'll encounter soon, the relationship is INVERSE.

1e) The text mentions that sometimes we know what EFFECT we want, and use our cause-and-effect reasoning to identify what would cause that particular effect.

If we want the dependent variable (the effect: grade) to be 80, what does our graph show that the value of the independent variable (the cause: study time per week) must be?

If we want our grade to be exactly 60, how much study time should we plan? (Of course teachers hope students have higher aspirations than this, but it *is* passing, that might be enough for some purposes, and we all have other things to do in life.)

1f) Notice that the original data stopped at (8 hrs, 80). Suppose that was all the actual data we had. You might wonder what would happen if you studied 9 hours, or even 10.

Extend your graph's line, using dashes or dots, to illustrate what would happen if the relationship illustrated by your actual data were to continue up to 10 hours.

Although you have presumably trustworthy data only up to 8 hours per week, you may want to see what it suggests about your grade if you were to study 9 or 10 hours. What does it show for a 9-hour grade?

A grade with 10 hours of study per week?

This is called EXTRAPOLATION, inferring something about values of the dependent variable when the independent variable lies *outside* (that's where the "extra" comes from) the range for which you have data. It's riskier than interpolation, and one shouldn't venture too far beyond one's actual data. People who do sometimes draw ridiculous conclusions from inappropriate extrapolation.

2) At the lower left is a table of data with some more realistic expectations about outside-of-class study time and likely grade. It produces a somewhat more complicated graph, illustrating the common tradeoff in economics between realism and complexity. Plot these data on the axes below. Again, this is just a more realistic illustration: No promises or guarantees, and "your mileage may vary," as they say in the digital realm.

Is this relationship direct or inverse?

By how many points does your likely grade increase if you add, to your time spent in class, one hour of outside-of-class study per week? A second hour? The fourth hour? The eighth?

(This illustrates the important "diminishing marginal" principle in economics: additional ("marginal") study raises your grade, but by smaller ("diminishing") amounts. We'll see this principle, in different contexts, many times.)

Outside-of-class study time, hrs/wk	Likely grade in this course, out of 100
0	40
1	55
2	65
3	75
4	80
5	85
6	90
7	94
8	97

Data for Figure 2

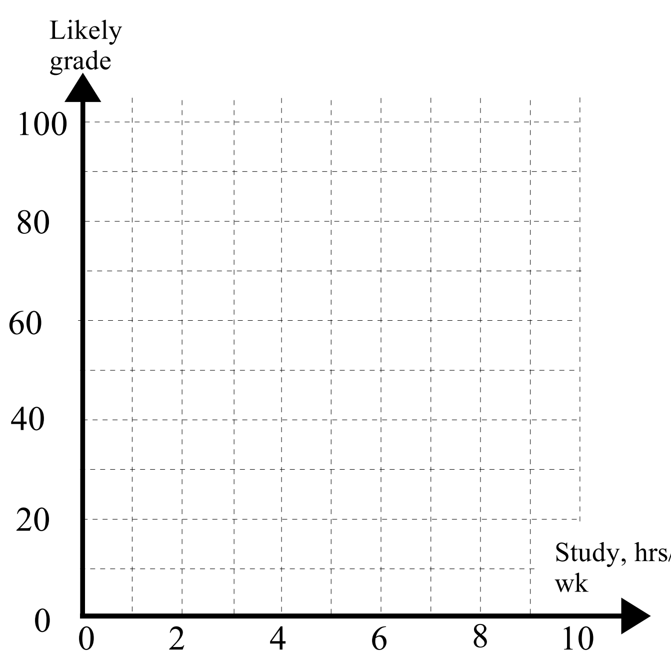


Figure 2: A bit more realism in the study/grade relationship

3) Of course the amount of time one studies is not the only determinant of her grade. Some students have better academic backgrounds than others: They went to a better high school, learned better study techniques, came from families that emphasized academic achievement and reading, and so forth. The table at the bottom of this page provides some data on a possible relationship between the quality of one's academic background and the amount of outside-of-class study time, per week, likely to result in a grade of "B" in this course.

a) Locate these points on the graph, label them with little O's, and draw a line connecting them. It will not be straight; this again reflects the "diminishing marginal" principle.

b) As we imagine the quality of academic preparation changing, the amount of study time probably needed to produce a "B" moves in the ______________direction, so the relationship between these two variables is

________________ .

c) Suppose you wanted to draw a graph showing how one's probable grade is related to the quality of his academic preparation, like our first and second graphs. What would you have to assume to be held constant, using the *ceteris paribus* assumption?

What would such a graph look like? (We are not going to draw it here, though of course you may.)

Quality of academic preparation (5 = average)	Outside-of-class study time (hrs/wk) for a B in this course
1	11
2	9
3	7.5
4	6
5	5
6	4.5
7	4
8	3.5
9	3

Data for Figure 3

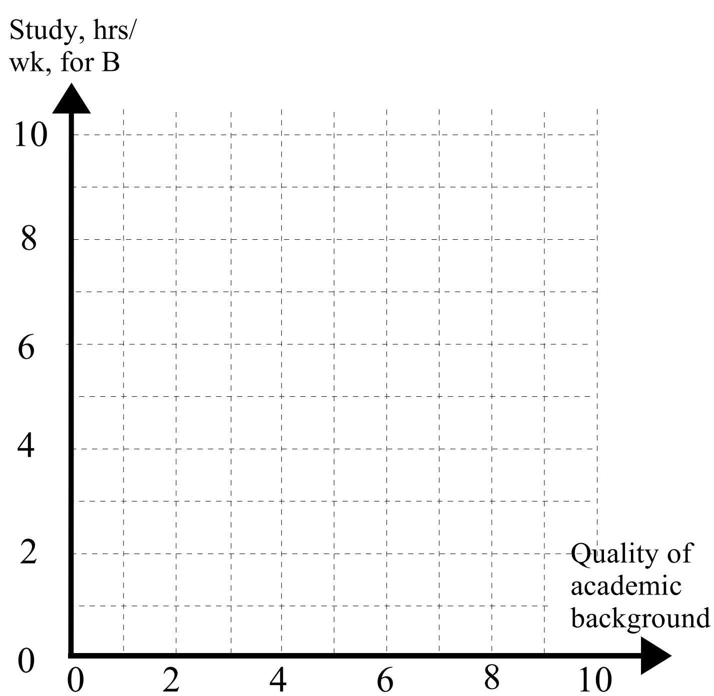


Figure 3: Hours for a B, as a function of quality of preparation

4. Now that I've tried to reinforce the importance of studying outside of class, we'll turn to more practice at drawing graphs. In each case a table of data and a set of axes are provided; you should plot the data on the axes and perhaps answer some questions about the resulting graph.

a)

Quantity of bananas you want to sell each week, in lbs.	Price you will be able to charge, per pound, to sell that quantity
2,000	$1.00
4,000	$0.80
6,000	$0.60
8,000	$0.40
10,000	$0.20

Data for Figure 4a

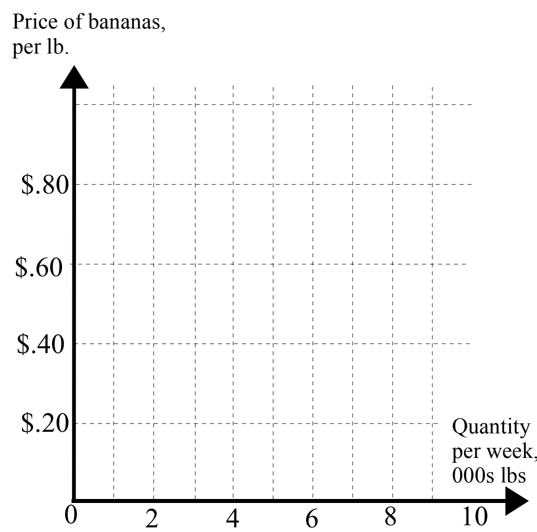


Figure 4a: Bananas

Is this relationship direct or inverse?

Does it make logical sense?

This is a *demand curve*, and its downward slope illustrates "the law of demand" that we will encounter in Chapter 2.

b) Here is a hypothetical relationship between one's income, in dollars per year, and the number of times he eats in restaurants each week.

Annual income, $	Eating out in restaurants, times per week
$20,000	0
$40.000	1
$60,000	3
$80,000	6

Data for Figure 4b

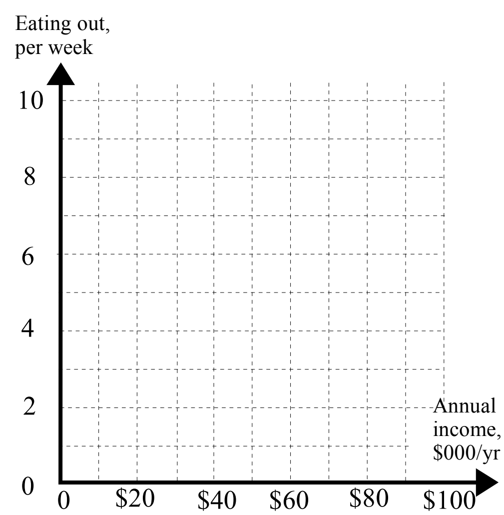


Figure 4b: Restauant meals and income

Is it direct or inverse?

Does the direction of this relationship (not necessarily my numbers) make logical sense?

The relationship between income and the quantity one will choose to buy (What is one important variable that is being held constant here, using *ceteris paribus*?) is called an *Engel curve*. We won't make much, if any, use of them in this course.

4c) Here are some data that relate a family's annual income to the number of pounds of cheap (watery, fatty) hamburger the family purchases each week.

Annual income, $	Pounds of cheap hamburger purchased per week
$0	0
$10,000	2
$20,000	4
$30.000	5
$40,000	6
$50,000	5
$60,000	3
$70,000	1
$80,000	0

Data for Figure 4c

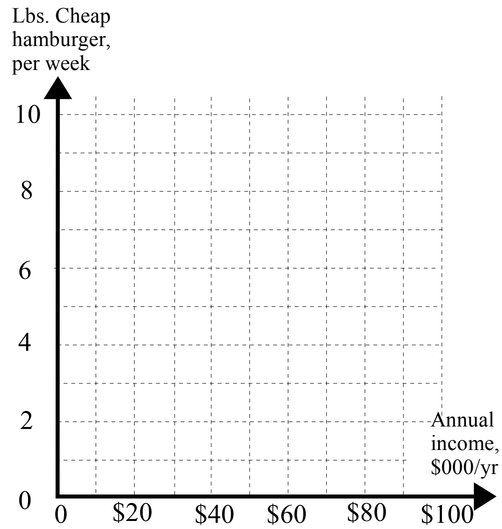


Figure 4c: Cheap hamburger and income

Between $0 and $40,000, is the relationship direct or inverse?

Above $40,000?

Does this relationship make logical sense? What is happening when the family's income begins to exceed $40,000?

Below $40,000, this cheap hamburger is called a *normal good* (the demand for it varies directly with income), but above $40,000 it is an *inferior good* (demand varies inversely with income). These concepts will appear in Chapter 2.

[By the way, if you're thinking about the relationship between price and quantity purchased, which of the two does it make more sense to consider the CAUSE (the independent variable), and which the EFFECT (the dependent variable)?

> If it seems reasonable to think of PRICE as the cause, and QUANTITY as the effect, that makes sense to most economists, too. But Alfred Marshall, the British economist whose *Principles of Economics* (1890) was very influential, preferred to imagine selling or buying various quantities (the independent variable) and to determine the maximum prices that could be charged, or minimum prices that would have to be offered, to be able to sell or buy each of those quantities. Marshall, in other words, interpreted quantity as the independent variable and price as dependent upon it, so he placed QUANTITY on the horizontal ("X") axis and PRICE on the vertical ("Y") axis. We economists, even those of us who usually prefer to think of quantity as dependent and price as independent, have learned to live with these axes.]

5) Would you expect the following relationships to be DIRECT or INVERSE [D or I]?

a) [Sample] Income (the cause) and number of times eating out in a nice restaurant annually: D

b) Income (the cause) and the number of articles of clothing purchased at Goodwill and Salvation Army stores annually, when a person's income is very low:

c) Income (the cause) and the number of articles of clothing purchased at Goodwill and Salvation Army stores annually, when a person's income is not high, but not extremely low either:

d) Number of times eating out in a nice restaurant annually (the cause) and amount of money available to spend on things other than nice-restaurant meals:

e) Temperature (the cause) and "how cold it feels":

f) Temperature (the cause) and "how hot it feels":

g) Winter wind velocity (the cause) and "how cold it feels":

h) Summer humidity (the cause) and "how hot it feels":

i) Summer wind velocity (the cause) and "how hot it feels":

Draw a simple graph (a straight line is easiest) that illustrates a direct and an inverse relationship between the causal (independent) variable and its effect (the dependent variable).

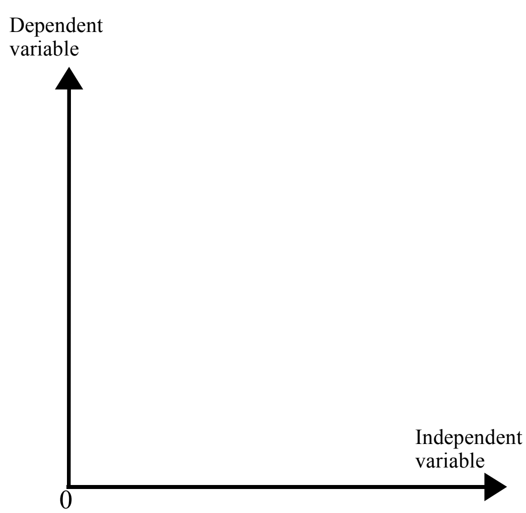
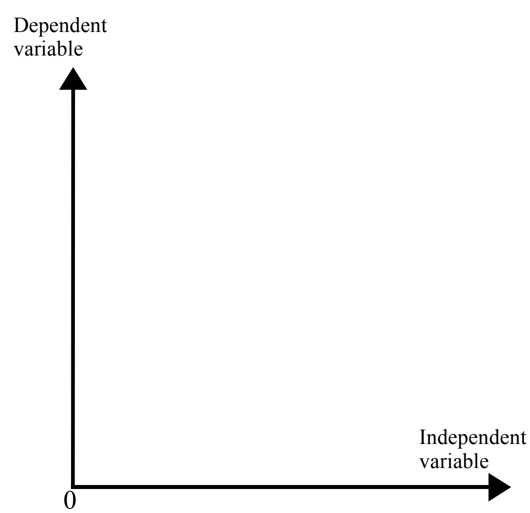


Figure 5a: A direct relationship...



... and Figure 5b: An inverse relationship

6) It is apparently becoming somewhat of a fashion to assert that some individuals, by virtue of their membership in a particular group, "have no choices."

a) Does an extremely wealthy person has "more choices" than a very poor person? Explain your answer. [The ENTIRE value of an exercise like this is in your explanation.]

b) Do very many single-parent poor women have the problem of deciding whether to hang the Picasso or the Matisse in the entrance hall, or whether to donate $10,000 to the Nature Conservancy or the city's struggling Opera Company? Might a very rich person face these choices?

Do multimillionaires have to decide whether to pay the utility bill or buy food, or whether to buy a set of used tires to replace the dangerously bald ones or new clothes for the kids? Do some poor people face these choices? What's the point?

c) If economics is the science of choice and it helps us to understand the causes and consequences of individuals' actions whenever choice is involved, does it follow—as has been claimed by a few critics—that economics is relevant only to rich white men? Why or why not?

d) Do men and women sometimes tend to make different choices when faced with the same alternatives? Might individuals of different races, ages, or religions make different choices, even if the circumstances were the same? Are there differences *in principle* among the *processes* of choice employed by individuals in each of these groups? What is the difference between "differences" and "differences in principle," anyway?

ANSWERS TO CHAPTER 1 EXERCISES

Page 2:

1a) You should have small circles at (0,0), (1, 10), at (2, 20), etc.

1b) Your straight line should have a 45-degree upward slope.

1c) 65; 25

1d) Increase; decrease

Page 3:

1f) 9 hours: 90; 10 hours: 100.

2. Direct; 15, 10, 5, 3 points

Page 4:

3(a): Your graph will be downward-sloping, like a rope with one end tied to a tree and the other lying on the ground.

3(b): OPPOSITE; inverse.

3(c): Amount of study time, in this case, would have to held constant.

Page 5:

4a) Inverse

4b) Direct

Page 6:

4c) Direct up to $40K, inverse above that.

Page 7:

5b) direct

5e) direct

5i) inverse

The two graphs will simply be upward, and downward, sloping straight lines, respectively.