How individuals do the best they can, and how they resolve the trade-off between earnings and free time

- Decision making under scarcity is a common problem because we usually have limited means available to meet our objectives.
- Economists model these situations, first by defining all of the feasible actions, then evaluating which of these actions is best, given the objectives.
- Opportunity costs describe the unavoidable trade-offs in the presence of scarcity: satisfying one objective more means satisfying other objectives less.
- A model of decision making under scarcity can be applied to the question of how much time to spend working, when facing a trade-off between more free time and more income.
- This model also helps to explain differences in the hours that people work in different countries, and the changes in our hours of work throughout history.

Imagine that you are working in New York, in a job that is paying you $15 an hour for a 40-hour working week, which gives you earnings of $600 per week. There are 168 hours in a week, so after 40 hours of work, you are left with 128 hours of free time for all your non-work activities, including leisure and sleep.

Suppose, by some happy stroke of luck, you are offered a job at a much higher wage—six times higher. Your new hourly wage is $90. Not only that, your prospective employer lets you choose how many hours you work each week.

Will you carry on working 40 hours per week? If you do, your weekly pay will be six times higher than before: $3,600. Or will you decide that you are satisfied with the goods you can buy with your weekly earnings of $600? You can now earn this by cutting your weekly hours to just 6 hours and 40 minutes (a six-day weekend!), and enjoy about 26% more free time than before. Or would you use this higher hourly wage rate to raise both your weekly earnings and your free time by some intermediate amount?

The idea of suddenly receiving a six-fold increase in your hourly wage and being able to choose your own hours of work might not seem very realistic. But we know from Unit 2 that technological progress since the Industrial Revolution has been accompanied by a dramatic rise in wages. In fact, the average real hourly earnings of American workers did increase more than six-fold during the twentieth century. And while employees ordinarily cannot just tell their employer how many hours they want to work, over long time periods the typical hours that we work do change. In part, this is a response to how much we prefer to work. As individuals, we can choose part-time work, although this may restrict our job options. Political parties also respond to the preferences of voters, so changes in typical working hours have occurred in many countries as a result of legislation that imposes maximum working hours.

So have people used economic progress as a way to consume more goods, enjoy more free time, or both? The answer is both, but in different proportions in different countries. While hourly earnings increased by more than six-fold for twentieth century Americans, their average annual work time fell by a little more than one-third. So people at the end of this

century enjoyed a four-fold increase in annual earnings with which they could buy goods and services, but a much smaller increase of slightly less than one-fifth in their free time. (The percentage increase in free time would be higher if you did not count time spent asleep as free time, but it is still small relative to the increase in earnings.) How does this compare with the choice you made when our hypothetical employer offered you a six-fold increase in your wage?

Figure 3.1 shows trends in income and working hours since 1870 in three countries.
As in Unit 1, income is measured as per-capita GDP in US dollars. This is not the same as average earnings, but gives us a useful indication of average income for the purposes of comparison across countries and through time. In the late nineteenth and early twentieth century, average income approximately trebled, and hours of work fell substantially. During the rest of the twentieth century, income per head rose four-fold.
Hours of work continued to fall in the Netherlands and France (albeit more slowly) but levelled off in the US, where there has been little change since 1960.

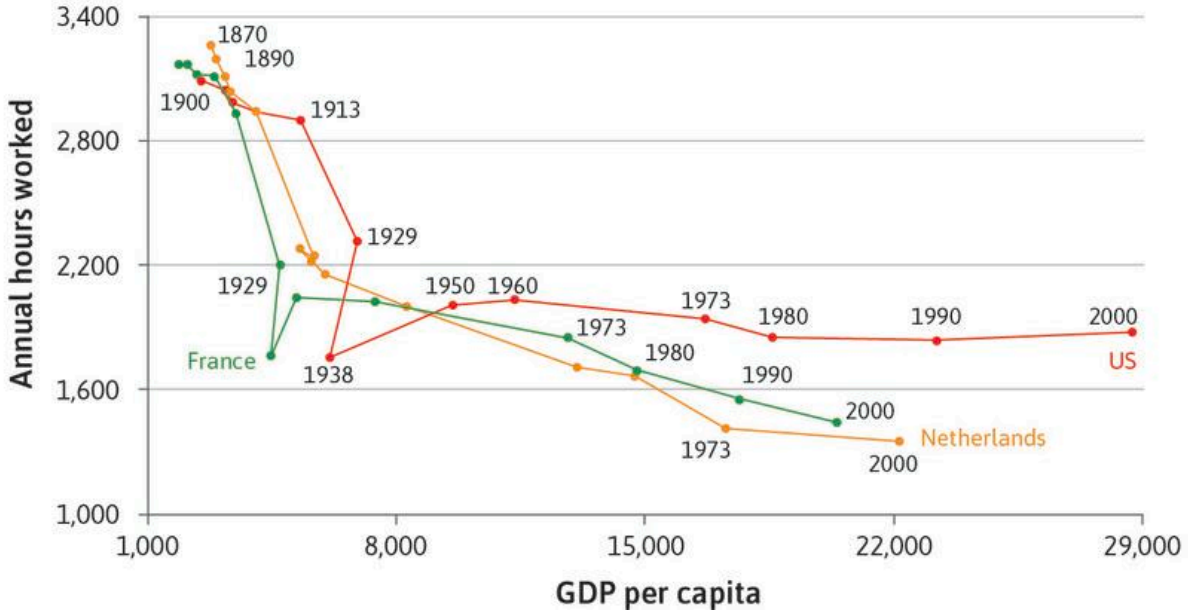


Figure 3.1 Annual hours of work and income (1870–2000).
View the latest data at OWiD

Maddison Project. 2013. 2013 edition. Michael Huberman and Chris Minns. 2007. 'The times they are not changin': Days and hours of work in Old and New Worlds, 1870–2000'. *Explorations in Economic History* 44 (4): pp. 538–567. GDP is measured at PPP in 1990 international Geary-Khamis dollars.

While many countries have experienced similar trends, there are still differences in outcomes. Figure 3.2 illustrates the wide disparities in free time and income between countries in 2013. Here we have calculated free time by subtracting average annual working hours from the number of hours in a year. You can see that the higher-income countries seem to have lower working hours and more free time, but there are also some striking differences between them. For example, the Netherlands and the US have similar levels of income, but Dutch workers have much more free time. And the US and Turkey have similar amounts of free time but a large difference in income.

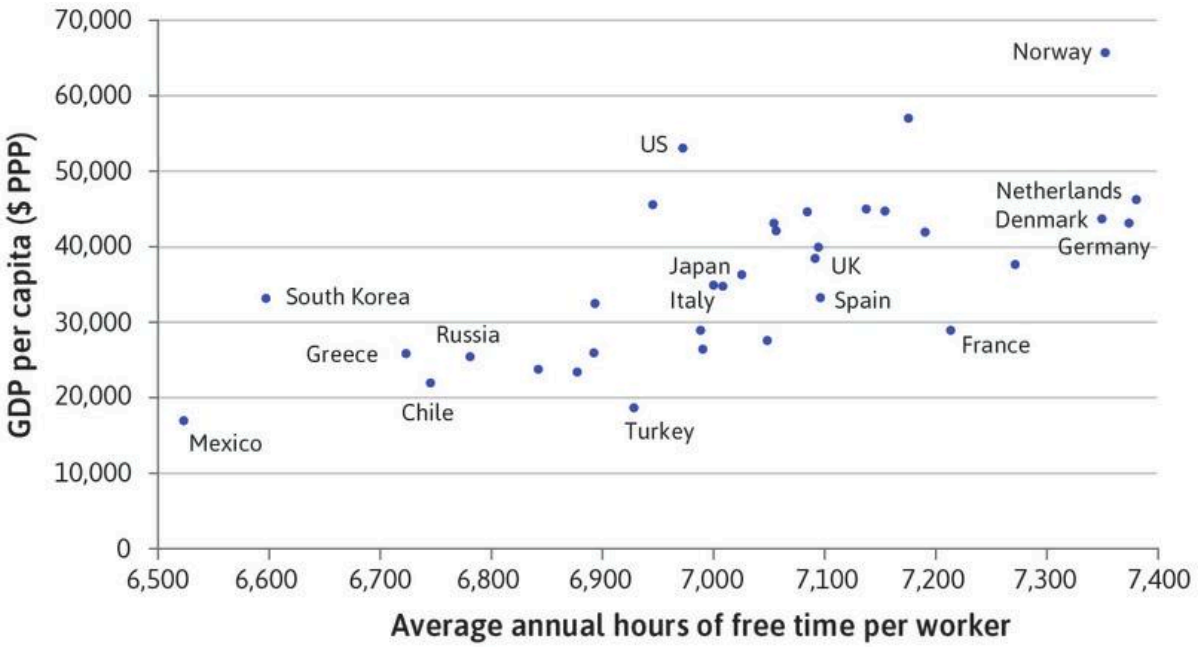


Figure 3.2 Annual hours of free time per worker and income (2013).
View the latest data at OWiD

OECD. Average annual hours actually worked per worker. OECD. Level of GDP per capita and productivity. Accessed June 2016. Data for South Korea refers to 2012.

In many countries there has been a huge increase in living standards since 1870. But in some places people have carried on working just as hard as before but consumed more, while in other countries people now have much more free time. Why has this happened? We will provide some answers to this question by studying a basic problem of economics—scarcity—and how we make choices when we cannot have all of everything that we want, such as goods and free time.

Study the model of decision making that we use carefully! It will be used repeatedly throughout the course, because it provides insight into a wide range of economic problems.

QUESTION 3.1 CHOOSE THE CORRECT ANSWER(S)

Currently you work for 40 hours per week at the wage rate of £20 an hour. Your free hours are defined as the number of hours not spent in work per week, which in this case is 24 hours × 7 days − 40 hours = 128 hours per week. Suppose now that your wage rate has increased by 25%. If you are happy to keep your total weekly income constant, then:

- ☐ Your total number of working hours per week will fall by 25%.
- ☐ Your total number of working hours per week will be 30 hours.
- ☐ Your total number of free hours per week will increase by 25%.
- ☐ Your total number of free hours per week will increase by 6.25%.

QUESTION 3.2 CHOOSE THE CORRECT ANSWER(S)

Look again at Figure 3.1, which depicts the annual number of hours worked against GDP per capita in the US, France and the Netherlands, between 1870 and 2000. Which of the following is true?

- ☐ An increase in GDP per capita causes a reduction in the number of hours worked.
- ☐ The GDP per capita in the Netherlands is lower than that in the US because Dutch people work fewer hours.
- ☐ Between 1870 and 2000, French people have managed to increase their GDP per capita more than ten-fold while more than halving the number of hours worked.
- ☐ On the basis of the evidence in the graph, one day French people will be able to produce a GDP per capita of over $30,000 with less than 1,000 hours of work.

3.1 Labour and production

In Unit 2 we saw that labour can be thought of as an input in the production of goods and services. Labour is work; for example the welding, assembling, and testing required to make a car. Work activity is often difficult to measure, which is an important point in later units because employers find it difficult to determine the exact amount of work that their employees are doing. We also cannot measure the effort required by different activities in a comparable way (for example, baking a cake versus building a car), so economists often measure labour simply as the number of hours worked by individuals engaged in production, and assume that as the number of hours worked increases, the amount of goods produced also increases.

As a student, you make a choice every day: how many hours to spend studying. There may be many factors influencing your choice: how much you enjoy your work, how difficult you find it, how much work your friends do, and so on. Perhaps part of the motivation to devote time to studying comes from your belief that the more time you spend studying, the higher the grade you will be able to obtain at the end of the course. In this unit, we will construct a simple model of a student's choice of how many hours to work, based on the assumption that the more time spent working, the better the final grade will be.

We assume a positive relationship between hours worked and final grade, but is there any evidence to back this up? A group of educational psychologists looked at the study behaviour of 84 students at Florida State University to identify the factors that affected their performance.[1]

Elizabeth Ashby Plant, Karl Anders Ericsson, Len Hill, and Kia Asberg. 2005. 'Why study time does not predict grade point average across college students: Implications of deliberate practice for academic performance.' *Contemporary Educational Psychology* 30 (1): pp. 96–116.

At first sight there seems to be only a weak relationship between the average number of hours per week the students spent studying and their Grade Point Average (GPA) at the end of the semester. This is in Figure 3.3.

The 84 students have been split into two groups according to their hours of study. The average GPA for those with high study time is 3.43—only just above the GPA of those with low study time.

	High study time (42 students)	**Low study time (42 students)**

Average GPA	3.43	3.36

Figure 3.3 Study time and grades.
Elizabeth Ashby Plant, Karl Anders Ericsson, Len Hill, and Kia Asberg. 2005. 'Why study time does not predict grade point average across college students: Implications of deliberate practice for academic performance.' *Contemporary Educational Psychology* 30 (1): pp. 96–116. Additional calculations were conducted by Ashby Plant, Florida State University, in June 2015.

Looking more closely, we discover this study is an interesting illustration of why we should be careful when we make *ceteris paribus* assumptions (remember from Unit 2 that this means 'holding other things constant'). Within each group of 42 students there are many potentially important differences. The conditions in which they study would be an obvious difference to consider: an hour working in a busy, noisy room may not be as useful as an hour spent in the library.

In Figure 3.4, we see that students studying in poor environments are more likely to study longer hours. Of these 42 students, 31 of them have high study time, compared with only 11 of the students with good environments. Perhaps they are distracted by other people around them, so it takes them longer to complete their assignments than students who work in the library.

	High study time	**Low study time**
Good environment	3.63 (11 students)	3.43 (31 students)
Poor environment	3.36 (31 students)	3.17 (11 students)

Figure 3.4 Average GPA in good and poor study environments.
Plant *et al.* 'Why study time does not predict grade point average across college students', ibid.

Now look at the average GPAs in the top row: if the environment is good, students who study longer do better—and you can see in the bottom row that high study time pays off for those who work in poor environments too. This relationship was not as clear when we didn't consider the effect of the study environment.

So, after taking into account environment and other relevant factors (including the students' past GPAs, and the hours they spent in paid work or partying), the psychologists estimated that an additional hour of study time per week raised a student's GPA at the end of the semester by 0.24 points on average. If we take two students who are the same in all respects except for study time, we predict that the one who studies for longer will have a GPA that is 0.24 points higher for each extra hour: study time raises GPA by 0.24 per hour, *ceteris paribus*.

EXERCISE 3.1 *CETERIS PARIBUS* ASSUMPTIONS

You have been asked to conduct a research study at your university, just like the one at Florida State University.

1. In addition to study environment, which factors do you think should ideally be held constant in a model of the relationship between study hours and final grade?
2. What information about the students would you want to collect beyond GPA, hours of study, and study environment?

Now imagine a student, whom we will call Alexei. He can vary the number of hours he spends studying. We will assume that, as in the Florida study, the hours he spends studying over the semester will increase the percentage grade that he will receive at the end, *ceteris*

paribus. This relationship between study time and final grade is represented in the table in Figure 3.5. In this model, study time refers to all of the time that Alexei spends learning, whether in class or individually, measured per day (not per week, as for the Florida students). The table shows how his grade will vary if he changes his study hours, if all other factors—his social life, for example—are held constant.

This is Alexei's **production function**production function A graphical or mathematical expression describing the amount of output that can be produced by any given amount or combination of input(s). The function describes differing technologies capable of producing the same thing. close: it translates the number of hours per day spent studying (his input of labour) into a percentage grade (his output). In reality, the final grade might also be affected by unpredictable events (in everyday life, we normally lump the effect of these things together and call it 'luck'). You can think of the production function as telling us what Alexei will get under normal conditions (if he is neither lucky nor unlucky).
If we plot this relationship on a graph, we get the curve in Figure 3.5. Alexei can achieve a higher grade by studying more, so the curve slopes upward. At 15 hours of work per day he gets the highest grade he is capable of, which is 90%. Any time spent studying beyond that does not affect his exam result (he will be so tired that studying more each day will not achieve anything), and the curve becomes flat.

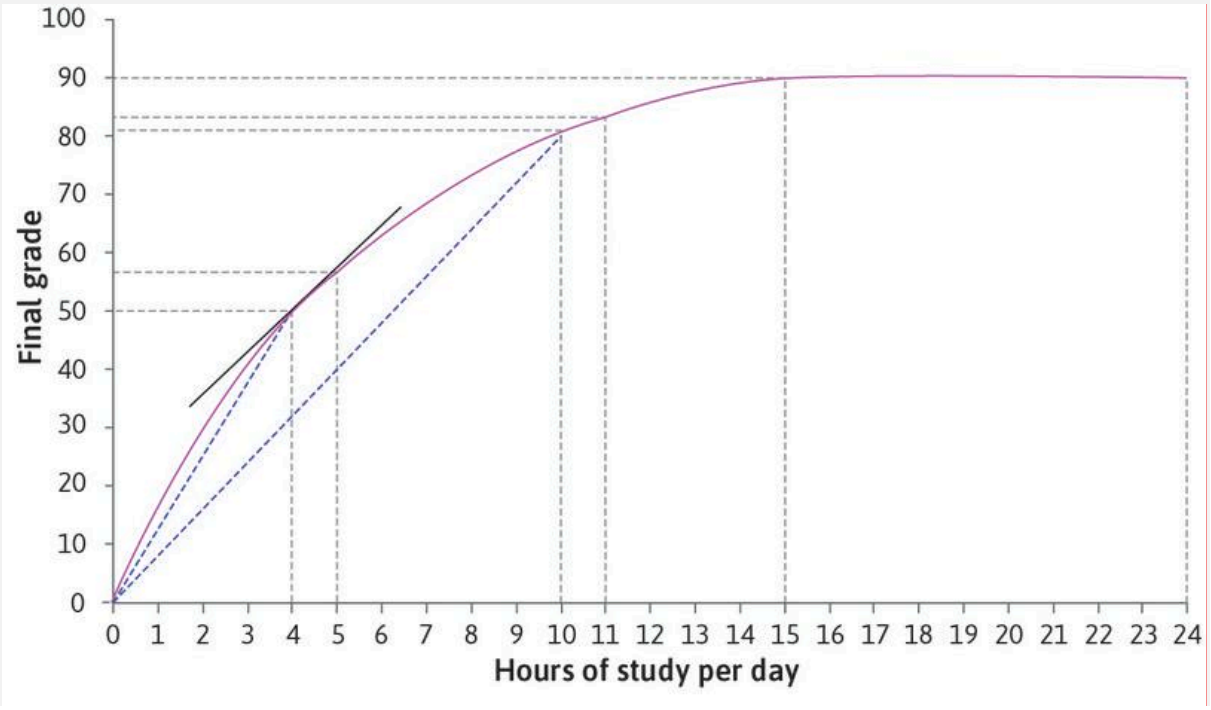
We can calculate Alexei's average product of labour, as we did for the farmers in Unit 2. If he works for 4 hours per day, he achieves a grade of 50. The **average product**average product Total output divided by a particular input, for example per worker (divided by the number of workers) or per worker per hour (total output divided by the total number of hours of labour put in). close—the average number of percentage points per hour of study—is 50 / 4 = 12.5. In Figure 3.5 it is the slope of a ray from the origin to the curve at 4 hours per day:

$$\text{slope} = \frac{\text{vertical distance}}{\text{horizontal distance}} = \frac{50}{4} = 12.5$$slope=vertical distancehorizontal distance=504=12.5

Alexei's **marginal product**marginal product The additional amount of output that is produced if a particular input was increased by one unit, while holding all other inputs constant. close is the increase in his grade from increasing study time by one hour.

Follow the steps in Figure 3.5 to see how to calculate the marginal product, and compare it with the average product.

1.
2.
3.
4.



Study hours	0	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15 or more
Grade	0	20	33	42	50	57	63	69	74	78	81	84	86	88	89	90

Alexei's production function
The curve is Alexei's production function. It shows how an input of study hours produces an output, the final grade.

Four hours of study per day
If Alexei studies for four hours his grade will be 50.

Ten hours of study per day
… and if he studies for 10 hours he will achieve a grade of 81.

Alexei's maximum grade
At 15 hours of study per day Alexei achieves his maximum possible grade, 90. After that, further hours will make no difference to his result: the curve is flat.

Increasing study time from 4 to 5 hours
Increasing study time from 4 to 5 hours raises Alexei's grade from 50 to 57. Therefore, at 4 hours of study, the marginal product of an additional hour is 7.

Increasing study time from 10 to 11 hours
Increasing study time from 10 to 11 hours raises Alexei's grade from 81 to 84. At 10 hours of study, the marginal product of an additional hour is 3. As we move along the curve, the slope of the curve falls, so the marginal product of an extra hour falls. The marginal product is diminishing.

The average product of an hour spent studying
When Alexei studies for four hours per day his average product is 50/4 = 12.5 percentage points, which is the slope of the ray from that point to the origin.

The marginal product is lower than the average product
At 4 hours per day the average product is 12.5. At 10 hours per day it is lower (81/10 = 8.1). The average product falls as we move along the curve. At each point the marginal product (the slope of the curve) is lower than the average product (the slope of the ray).

The marginal product is the slope of the tangent
The marginal product at four hours of study is approximately 7, which is the increase in the grade from one more hour of study. More precisely, the marginal product is the slope of the tangent at that point, which is slightly higher than 7.

Figure 3.5 How does the amount of time spent studying affect Alexei's grade?
At each point on the production function, the marginal product is the increase in the grade from studying one more hour. The marginal product corresponds to the slope of the production function.

Alexei's production function in Figure 3.5 gets flatter the more hours he studies, so the marginal product of an additional hour falls as we move along the curve. The marginal product is **diminishing**

diminishing returns A situation in which the use of an additional unit of a factor of production results in a smaller increase in output than the previous increase. *Also known as: diminishing marginal returns in production*

close. The model captures the idea that an extra hour of study helps a lot if you are not studying much, but if you are already studying a lot, then studying even more does not help very much.

ng marginal productivity

In Figure 3.5, output increases as the input increases, but the marginal product falls—the function becomes gradually flatter. A production function with this shape is described as **concave**

concave function A function of two variables for which the line segment between any two points on the function lies entirely below the curve representing the function (the function is convex when the line segment lies above the function).

close.

Leibniz: Concave and convex functions

If we compare the marginal and average products at any point on Alexei's production function, we find that the marginal product is below the average product. For example, when he works for four hours his average product is 50/4 = 12.5 points per hour, but an extra hour's work raises his grade from 50 to 57, so the marginal product is 7. This happens because the marginal product is diminishing: each hour is less productive than the ones that came before. And it implies that the average product is also diminishing: each additional hour of study per day lowers the average product of all his study time, taken as a whole.

This is another example of the diminishing average product of labour that we saw in Unit 2. In that case, the average product of labour in food production (the food produced per worker) fell as more workers cultivated a fixed area of land.

Lastly, notice that if Alexei was already studying for 15 hours a day, the marginal product of an additional hour would be zero. Studying more would not improve his grade. As you might know from experience, a lack of either sleep or time to relax could even lower Alexei's grade if he worked more than 15 hours a day. If this were the case, then his production function would start to slope downward, and Alexei's marginal product would become negative.

Marginal change is an important and common concept in economics. You will often see it marked as a slope on a diagram. With a production function like the one in Figure 3.5, the slope changes continuously as we move along the curve. We have said that when Alexei studies for 4 hours a day the marginal product is 7, the increase in the grade from one more hour of study. Because the slope of the curve changes between 4 and 5 hours on the horizontal axis, this is only an approximation to the actual marginal product. More precisely, the marginal product is the rate at which the grade increases, per hour of additional study. In Figure 3.5 the true marginal product is the slope of the **tangent** **tangency** When two curves share one point in common but do not cross. The tangent to a curve at a given point is a straight line that touches the curve at that point but does not cross it. close to the curve at 4 hours. In this unit, we will use approximations so that we can work in whole numbers, but you may notice that sometimes these numbers are not quite the same as the slopes.

EXERCISE 3.2 PRODUCTION FUNCTIONS

1. Draw a graph to show a production function that, unlike Alexei's, becomes steeper as the input increases.
2. Can you think of an example of a production process that might have this shape? Why would the slope get steeper?
3. What can you say about the marginal and average products in this case?

MARGINAL PRODUCT

The marginal product is the rate of change of the grade at 4 hours of study. Suppose Alexei has been studying for 4 hours a day, and studies for 1 minute longer each day (a total of 4.016667

hours). Then, according to the graph, his grade will rise by a very small amount—about 0.124. A more precise estimate of the marginal product (the rate of change) would be:

$$0.1240.016667=7.440.1240.016667=7.44$$

If we looked at smaller changes in study time even further (the rise in grade for each additional second of study per day, for example) we would get closer to the true marginal product, which is the slope of the tangent to the curve at 4 hours of study.

QUESTION 3.3 CHOOSE THE CORRECT ANSWER(S)

Figure 3.5 shows Alexei's production function, with the final grade (the output) related to the number of hours spent studying (the input).
Which of the following is true?

- ☐ The marginal product and average product are approximately the same for the initial hour.
- ☐ The marginal product and the average product are both constant beyond 15 hours.
- ☐ The horizontal production function beyond 15 hours means that studying for more than 15 hours is detrimental to Alexei's performance.
- ☐ The marginal product and the average product at 20 hours are both 4.5.

3.2 Preferences

If Alexei has the production function shown in Figure 3.5, how many hours per day will he choose to study? The decision depends on his **preferences**preferences A description of the benefit or cost we associate with each possible outcome. close—the things that he cares about. If he cared only about grades, he should study for 15 hours a day. But, like other people, Alexei also cares about his free time—he likes to sleep, go out or watch TV. So he faces a trade-off: how many percentage points is he willing to give up in order to spend time on things other than study?
We illustrate his preferences using Figure 3.6, with free time on the horizontal axis and final grade on the vertical axis. Free time is defined as all the time that he does not spend studying. Every point in the diagram represents a different combination of free time and final grade. Given his production function, not every combination that Alexei would want will be possible, but for the moment we will only consider the combinations that he would prefer.

We can assume:

- For a given grade, he prefers a combination with more free time to one with less free time. Therefore, even though both A and B in Figure 3.6 correspond to a grade of 84, Alexei prefers A because it gives him more free time.

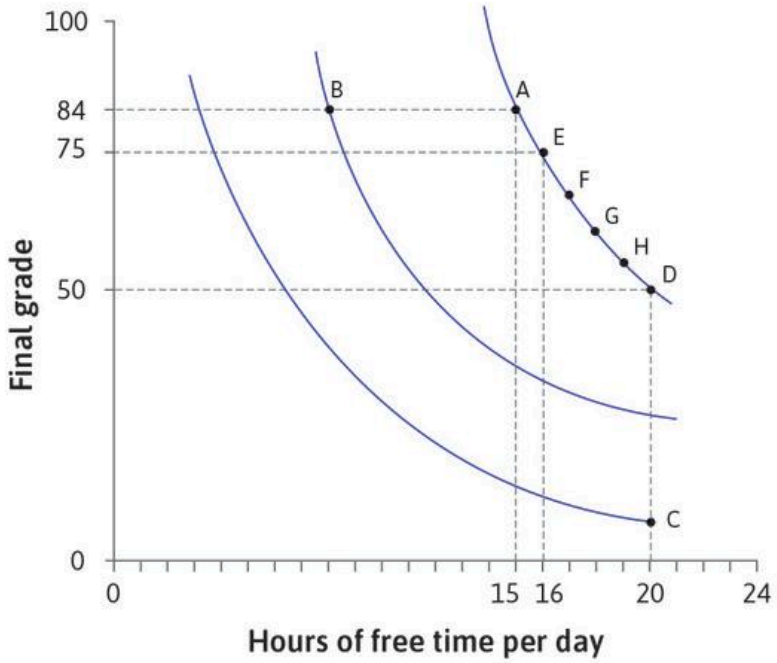
- Similarly, if two combinations both have 20 hours of free time, he prefers the one with a higher grade.
- But compare points A and D in the table. Would Alexei prefer D (low grade, plenty of time) or A (higher grade, less time)? One way to find out would be to ask him.

Suppose he says he is indifferent between A and D, meaning he would feel equally satisfied with either outcome. We say that these two outcomes would give Alexei the same **utility** **utility** A numerical indicator of the value that one places on an outcome, such that higher valued outcomes will be chosen over lower valued ones when both are feasible. close. And we know that he prefers A to B, so B provides lower utility than A or D.

A systematic way to graph Alexei's preferences would be to start by looking for all of the combinations that give him the same utility as A and D. We could ask Alexei another question: 'Imagine that you could have the combination at A (15 hours of free time, 84 points). How many points would you be willing to sacrifice for an extra hour of free time?' Suppose that after due consideration, he answers 'nine'. Then we know that he is indifferent between A and E (16 hours, 75 points). Then we could ask the same question about combination E, and so on until point D. Eventually we could draw up a table like the one in Figure 3.6. Alexei is indifferent between A and E, between E and F, and so on, which means he is indifferent between all of the combinations from A to D.

The combinations in the table are plotted in Figure 3.6, and joined together to form a downward-sloping curve, called an **indifference curve** **indifference curve** A curve of the points which indicate the combinations of goods that provide a given level of utility to the individual. close, which joins together all of the combinations that provide

equal utility or ‘satisfaction’.



	A	E	F	G	H	
Hours of free time	15	16	17	18	19	20
Final grade	84	75	67	60	54	50

Alexei prefers more free time to less free time

Combinations A and B both deliver a grade of 84, but Alexei will prefer A because it has more free time.

Alexei prefers a high grade to a low grade

At combinations C and D Alexei has 20 hours of free time per day, but he prefers D because it gives him a higher grade.

Indifference

… but we don’t know whether Alexei prefers A or E, so we ask him: he says he is indifferent.

More combinations giving the same utility

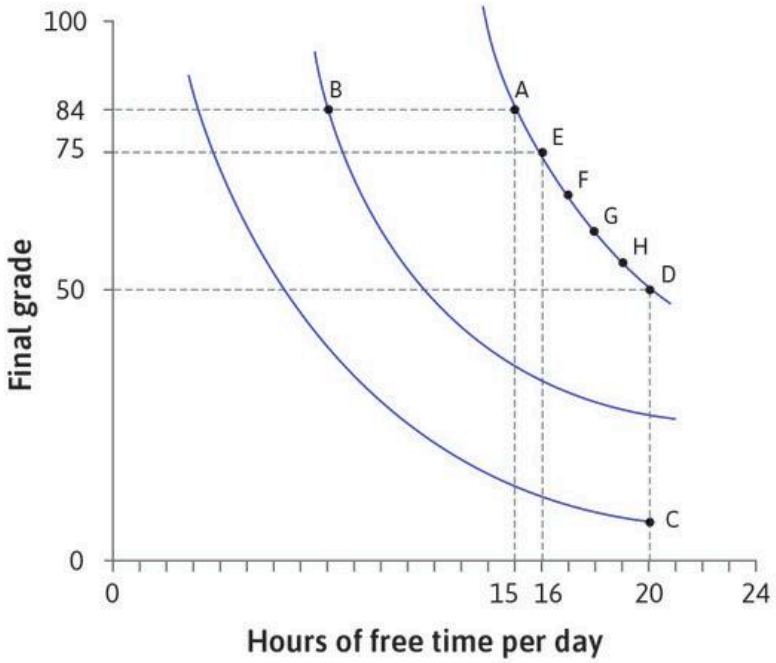
Alexei says that F is another combination that would give him the same utility as A and E.

Constructing the indifference curve

By asking more questions, we discover that Alexei is indifferent between all of the combinations between A and D.

Constructing the indifference curve

These points are joined together to form an indifference curve.



Other indifference curves

Indifference curves can be drawn through any point in the diagram, to show other points giving the same utility. We can construct other curves starting from B or C in the same way as before, by finding out which combinations give the same amount of utility.

Figure 3.6 Mapping Alexei's preferences.

If you look at the three curves drawn in Figure 3.6, you can see that the one through A gives higher utility than the one through B. The curve through C gives the lowest utility of the three. To describe preferences we don't need to know the exact utility of each option; we only need to know which combinations provide more or less utility than others.

The curves we have drawn capture our typical assumptions about people's preferences between two goods. In other models, these will often be **consumption goods**

consumption good A good or service that satisfies the needs of consumers over a short period.

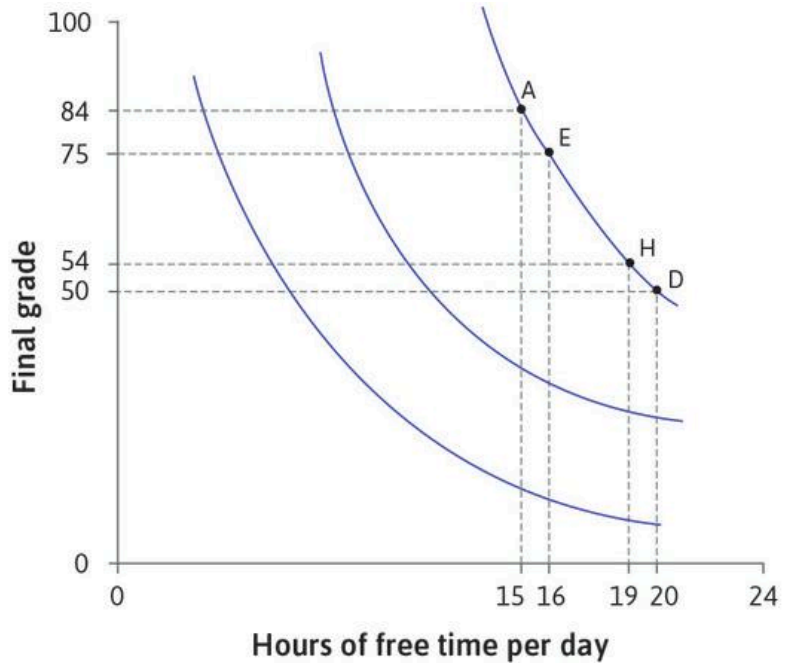
close such as food or clothing, and we refer to the person as a consumer. In our model of a student's preferences, the goods are 'final grade' and 'free time'. Notice that:

- *Indifference curves slope downward due to trade-offs*: If you are indifferent between two combinations, the combination that has more of one good must have less of the other good.
- *Higher indifference curves correspond to higher utility levels*: As we move up and to the right in the diagram, further away from the origin, we move to combinations with more of both goods.
- *Indifference curves are usually smooth*: Small changes in the amounts of goods don't cause big jumps in utility.
- *Indifference curves do not cross*: Why? See Exercise 3.3.
- *As you move to the right along an indifference curve, it becomes flatter.*

To understand the last property in the list, look at Alexei's indifference curves, which are plotted again in Figure 3.7. If he is at A, with 15 hours of free time and a grade of 84, he would be willing to sacrifice 9 percentage points for an extra hour of free time, taking him to E (remember that he is indifferent between A and E). We say that his **marginal rate of substitution (MRS)**

marginal rate of substitution (MRS) The trade-off that a person is willing to make between two goods. At any point, this is the slope of the indifference curve. *See also: marginal rate of transformation.*close between grade points and free time at A is nine; it is the reduction in his grade that would keep Alexei's utility constant following a one-hour increase of free time.

We have drawn the indifference curves as becoming gradually flatter because it seems reasonable to assume that the more free time and the lower the grade he has, the less willing he will be to sacrifice further percentage points in return for free time, so his MRS will be lower. In Figure 3.7 we have calculated the MRS at each combination along the indifference curve. You can see that, when Alexei has more free time and a lower grade, the MRS—the number of percentage points he would give up to get an extra hour of free time—gradually falls.



Alexei's indifference curves
The diagram shows three indifference curves for Alexei. The curve furthest to the left offers the lowest satisfaction.

Point A
At A, he has 15 hours of free time and his grade is 84.

Alexei is indifferent between A and E

He would be willing to move from A to E, giving up 9 percentage points for an extra hour of free time. His marginal rate of substitution is 9. The indifference curve is steep at A.

Alexei is indifferent between H and D

At H he is only willing to give up 4 points for an extra hour of free time. His MRS is 4. As we move down the indifference curve, the MRS diminishes, because points become scarce relative to free time. The indifference curve becomes flatter.

All combinations with 15 hours of free time

Look at the combinations with 15 hours of free time. On the lowest curve the grade is low, and the MRS is small. Alexei would be willing to give up only a few points for an hour of free time. As we move up the vertical line the indifference curves are steeper: the MRS increases.

All combinations with a grade of 54

Now look at all the combinations with a grade of 54. On the curve furthest to the left, free time is scarce, and the MRS is high. As we move to the right along the red line he is less willing to give up points for free time. The MRS decreases–the indifference curves get flatter.

Figure 3.7 The marginal rate of substitution.

The MRS is just the slope of the indifference curve, and it falls as we move to the right along the curve. If you think about moving from one point to another in Figure 3.7, you can see that the indifference curves get flatter if you increase the amount of free time, and steeper if you increase the grade. When free time is scarce relative to grade points, Alexei is less willing to sacrifice an hour for a higher grade: his MRS is high and his indifference curve is steep.

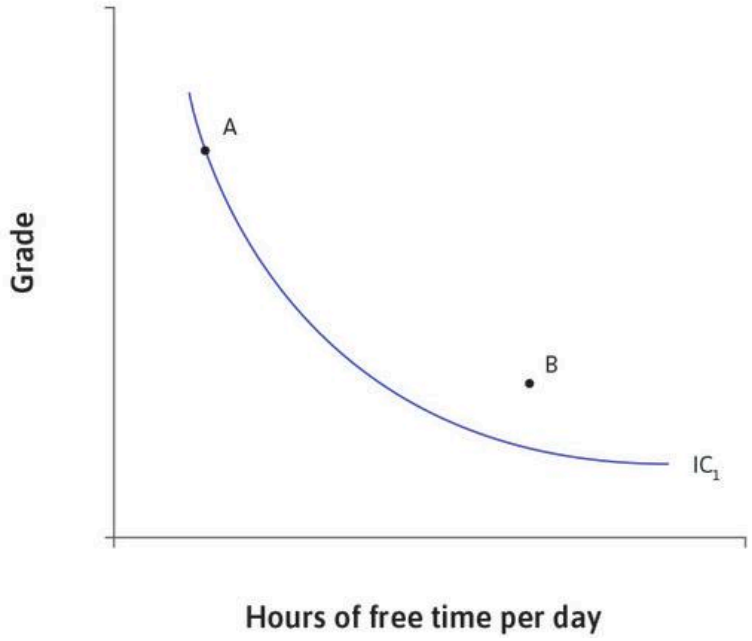
As the analysis in Figure 3.7 shows, if you move up the vertical line through 15 hours, the indifference curves get steeper: the MRS increases. For a given amount of free time, Alexei is willing to give up more grade points for an additional hour when he has a lot of points compared to when he has few (for example, if he was in danger of failing the course). By the time you reach A, where his grade is 84, the MRS is high; grade points are so plentiful here that he is willing to give up 9 percentage points for an extra hour of free time.

Leibniz: Indifference curves and the marginal rate of substitution

You can see the same effect if you fix the grade and vary the amount of free time. If you move to the right along the horizontal line for a grade of 54, the MRS becomes lower at each indifference curve. As free time becomes more plentiful, Alexei becomes less and less willing to give up grade points for more time.

EXERCISE 3.3 WHY INDIFFERENCE CURVES NEVER CROSS

In the diagram below, IC_1 is an indifference curve joining all the combinations that give the same level of utility as A. Combination B is not on IC_1.



1. Does combination B give higher or lower utility than combination A? How do you know?
2. Draw a sketch of the diagram, and add another indifference curve, IC_2, that goes through B and crosses IC_1. Label the point at which they cross as C.
3. Combinations B and C are both on IC_2. What does that imply about their levels of utility?
4. Combinations C and A are both on IC_1. What does that imply about their levels of utility?
5. According to your answers to (3) and (4), how do the levels of utility at combinations A and B compare?
6. Now compare your answers to (1) and (5), and explain how you know that indifference curves can never cross.

EXERCISE 3.4 YOUR MARGINAL RATE OF SUBSTITUTION

Imagine that you are offered a job at the end of your university course with a salary per hour (after taxes) of £12.50. Your future employer then says that you will work for 40 hours per week leaving you with 128 hours of free time per week. You tell a friend: 'at that wage, 40 hours is exactly what I would like.'

1. Draw a diagram with free time on the horizontal axis and weekly pay on the vertical axis, and plot the combination of hours and the wage corresponding to your job offer, calling it A. Assume you need about 10 hours a day for sleeping and eating, so you may want to draw the horizontal axis with 70 hours at the origin.
2. Now draw an indifference curve so that A represents the hours you would have chosen yourself.
3. Now imagine you were offered another job requiring 45 hours of work per week. Use the indifference curve you have drawn to estimate the level of weekly pay that would make you indifferent between this and the original offer.

4. Do the same for another job requiring 35 hours of work per week. What level of weekly pay would make you indifferent between this and the original offer?
5. Use your diagram to estimate your marginal rate of substitution between pay and free time at A.

QUESTION 3.4 CHOOSE THE CORRECT ANSWER(S)

Figure 3.6 shows Alexei's indifference curves for free time and final grade. Which of the following is true?

- ☐ Alexei prefers C to B because at C he has more free time.
- ☐ Alexei is indifferent between the grade of 84 with 15 hours of free time, and the grade of 50 with 20 hours of free time.
- ☐ Alexei prefers D to C, because at D he has the same grade and more free time.
- ☐ At G, Alexei is willing to give up 2 hours of free time for 10 extra grade points.

Check my answers

QUESTION 3.5 CHOOSE THE CORRECT ANSWER(S)

What is the marginal rate of substitution (MRS)?

- ☐ The ratio of the amounts of the two goods at a point on the indifference curve.
- ☐ The amount of one good that the consumer is willing to trade for one unit of the other.
- ☐ The change in the consumer's utility when one good is substituted for another.
- ☐ The slope of the indifference curve.

3.3 Opportunity costs

Alexei faces a dilemma: we know from looking at his preferences that he wants both his grade and his free time to be as high as possible. But given his production function, he cannot increase his free time without getting a lower grade in the exam. Another way of expressing this is to say that free time has an **opportunity cost****opportunity cost** When taking an action implies forgoing the next best alternative action, this is the net benefit of the foregone alternative. close: to get more free time, Alexei has to forgo the opportunity of getting a higher grade.

In economics, opportunity costs are relevant whenever we study individuals choosing between alternative and mutually exclusive courses of action. When we consider the cost of taking action A we include the fact that if we do A, we cannot do B. So 'not doing B' becomes part of the cost of doing A. This is called an opportunity cost because doing A means forgoing the opportunity to do B.

Imagine that an accountant and an economist have been asked to report the cost of going to a concert, A, in a theatre, which has a $25 admission cost. In a nearby park there is concert B, which is free but happens at the same time.

ACCOUNTANT

> The cost of concert A is your 'out-of-pocket' cost: you paid $25 for a ticket, so the cost is $25.

ECONOMIST

> But what do you have to give up to go to concert A? You give up $25, plus the enjoyment of the free concert in the park. So the cost of concert A for you is the out-of-pocket cost plus the opportunity cost.

Suppose that the most you would have been willing to pay to attend the free concert in the park (if it wasn't free) was $15. The benefit of your next best alternative to concert A would be $15 of enjoyment in the park. This is the opportunity cost of going to concert A.

So the total **economic cost** **economic cost** The out-of-pocket cost of an action, plus the opportunity cost. close of concert A is $25 + $15 = $40. If the pleasure you anticipate from being at concert A is greater than the economic cost, say $50, then you will forego concert B and buy a ticket to the theatre. On the other hand, if you anticipate $35 worth of pleasure from concert A, then the economic cost of $40 means you will not choose to go to the theatre. In simple terms, given that you have to pay $25 for the ticket, you will instead opt for concert B, pocketing the $25 to spend on other things and enjoying $15 worth of benefit from the free park concert.

Why don't accountants think this way? Because it is not their job. Accountants are paid to keep track of money, not to provide decision rules on how to choose among alternatives, some of which do not have a stated price. But making sensible decisions and predicting how sensible people will make decisions involve more than keeping track of money. An accountant might argue that the park concert is irrelevant:

ACCOUNTANT

> Whether or not there is a free park concert does not affect the cost of going to the concert A. The cost to you is always $25.

ECONOMIST

> But whether or not there is a free park concert can affect whether you go to concert A or not, because it changes your available options. If your enjoyment from A is $35 and your next best alternative is staying at home, with enjoyment of $0, you will choose concert A. However, if concert B is available, you will choose it over A.

In Unit 2, we said that if an action brings greater net benefits than the next best alternative, it yields an **economic rent**economic rent A payment or other benefit received above and beyond what the individual would have received in his or her next best alternative (or reservation option). *See also: reservation option.*close and you will do it. Another way of saying this is that you receive an economic rent from taking an action when it results in a benefit greater than its economic cost (the sum of out-of-pocket and opportunity costs). The table in Figure 3.8 summarizes the example of your choice of which concert to attend.

	A high value on the theatre choice (A)	A low value on the theatre ch
Out-of-pocket cost (price of ticket for A)	$25	$25
Opportunity cost (foregone pleasure of B, park concert)	$15	$15
Economic cost (sum of out-of-pocket and opportunity cost)	$40	$40
Enjoyment of theatre concert (A)	$50	$35
Economic rent (enjoyment minus economic cost)	$10	–$5
Decision	A: Go to the theatre concert.	B: Go to the park concert.

Figure 3.8 Opportunity costs and economic rent: Which concert will you choose?

QUESTION 3.6 CHOOSE THE CORRECT ANSWER(S)

You are a taxi driver in Melbourne who earns A$50 for a day's work. You have been offered a one-day ticket to the Australian Open for A$40. As a tennis fan, you value the experience at A$100. With this information, what can we say?

- ☐ The opportunity cost of the day at the Open is A$40.
- ☐ The economic cost of the day at the Open is A$40.
- ☐ The economic rent of the day at the Open is A$10.
- ☐ You would have paid up to A$100 for the ticket.

Check my answers

EXERCISE 3.5 OPPORTUNITY COSTS

The British government introduced legislation in 2012 that gave universities the option to raise their tuition fees. Most chose to increase annual tuition fees for students from £3,000 to £9,000.

Does this mean that the cost of going to university has tripled? (Think about how an accountant and an economist might answer this question. To simplify, assume that the tuition fee is an 'out of pocket' cost. Ignore student loans.)