

EXERCISE ANSWERS UNIT 2

UNIT 2

ANSWERS TO EXERCISES



EXERCISE 2.1 DESIGNING A MODEL

For a country (or city) of your choice, look up a map of the railway or public transport network.

Much like economic models, maps are simplified representations of reality. They include relevant information, while abstracting from irrelevant details.

1. How do you think the designer selected which features of reality to include in the map you have selected?
2. In what way is a map not like an economic model?



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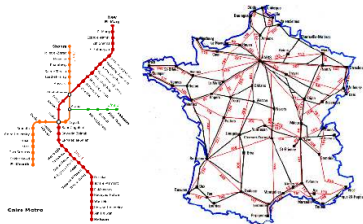
Introduction

The aim of this question is to encourage students to reflect on why we use models and other cognitive simplifications, and what their strengths and weaknesses are.

Students should appreciate that a model is always a reduction of reality and that the choices made in terms of what to include in a model should be guided by the model's purpose. The models we use in economics are never a perfect representation of reality, and often designed to answer very specific questions. This means that while a model may be useful to answer one question, it may not be the right tool to answer other questions. To decide how to use economic models in a meaningful way, we need to precisely know the assumptions a model is based on.

Answer

A map is not like an economic model. It is a simplification, but it is not used to make predictions.



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When designing the model, we focus on the most essential information to describe the transportation system. This may include: Names of the stops, the names of the bus/metro/train lines and the points at which there are interchanges between the lines.

The model will need to be a simplification of reality, and may also not be in true scale. The inaccuracies (for example, difference in scaling) will cause some aspects of the model to be an approximation only. For instance, the geographical relation between stations/stops may only be roughly correct. Also, the connections between stations may not exactly match the actual routes (the correct route might be more of a curve and the modeller may use a straight line instead). Other geographical and demographic details such as information on altitudes, location of amenities or information on the population may be left out to improve readability.

More generally:

- All models must be a reduction of the complex realities we live in to make them usable.
- Models are designed for the questions one would like to answer. Irrelevant information is left out.
- The purpose of the public transport and railway model is to answer the question: what is the best way to get from A to B using public transport services? Hence information that does not improve the quality of the answer to this specific question is left out.

### Marking guidance

A good answer will elaborate on:

What goes exactly into the model

- Names of stops
- Name of specific bus/train line
- Interchanges between lines
- Station facilities (lift, escalator...)

What goes approximately into the model

- Geographical relation between stations/stops is only roughly correct
- Connection between stations may not exactly match route (straight line between station/stops)

What may not go into the model

- Other geographical information such as altitude, location of amenities, information on population, and so on.

### Teaching ideas

Instructors could ask students to bring maps to the classroom, pin them up and let students discuss the features of the map in groups. Instructors could be provocative and suggest that all these models we use are useless, as they don't include important parts of reality. This may steer a fruitful discussion.

- Kay, John, 2011. *Obliquity*, London: Profile books. Chapter 12, Abstraction – why models are imperfect descriptions of reality.
- Kay, John, 2011. 'The map is not the territory', Institute for New Economic Thinking. (<http://tinyco.re/6669294>)

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**EXERCISE 2.2 USING *CETERIS PARIBUS***

Suppose you build a model of the market for umbrellas, in which the predicted number of umbrellas sold by a shop depends on their colour and price, *ceteris paribus*.

1. The colour and the price are variables used to predict sales. Which other variables are being held constant?

Which of the following questions do you think this model might be able to answer? In each case, suggest improvements to the model that might help you to answer the question.

2. Why are annual umbrella sales higher in the capital city than in other towns?
3. Why are annual umbrella sales higher in some shops in the capital city than others?
4. Why have weekly umbrella sales in the capital city risen over the last six months?

**Introduction**

The aim of the question is for students to reflect on what a *ceteris paribus* decision means, when it is safe to make *ceteris paribus* assumptions and when it may be important to relax such assumptions. On a more general level, this question will train students to think carefully about assumptions in models.

**Answer**

1. In the example in this exercise, all variables apart from colour and price are held constant. For example weather, location, quality are held constant.
2. It depends. It seems unlikely that differences in price will provide a full explanation. It will also be necessary to include other factors such as the population in the regional area, regional weather, average regional income, and so on.
3. As above, only in so far as differences in sales are due to differences in price and colour. Ideally, we would want to include a range of seller characteristics to better understand the differences between shops.
4. As above. The key factors to include here are time-varying, such as weekly rainfall.

**Marking guidance**

Good answers need to define the *ceteris paribus* assumption and correctly apply it to the market for umbrellas.

**Teaching ideas**

This relatively straightforward question could be asked in a lecture as a think-pair-share task. For 2-4, one could use audience response software to let students vote on the answer and then discuss the intuition.

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## EXERCISE 2.3 ISOCOST LINES

Suppose the wage is £10 but the price of coal is only £5.

1. What is the relative price of labour?
2. Using the method in the text, write down the equation of the isocost line for  $c = £60$ , and rewrite it in the standard form  $y = a + b x$ .
3. Write the equations for the £30 and £90 isocost lines in the standard form too, and draw all three lines on a diagram. How does the set of isocost lines for these input prices compare to the ones for  $w = 10$  and  $p = 20$ ?

## Introduction

In this exercise students practice working with isocost lines, and apply the concept to examples different from the text. If teaching with a stronger focus on mathematics, this will be a good practice exercise.

## Answer

1. The relative price of labour tells us how much the firm has to reduce coal purchases to maintain the same total costs if one more labourer had been hired. It is also the slope of the isocost line. This equals:

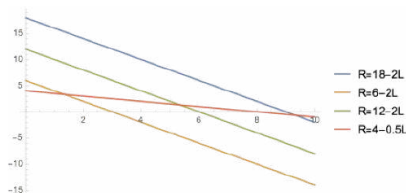
$$-(w/p) = -(10/5) = -2$$

If one spends £10 more on labour by hiring an extra worker, then to keep total costs constant one needs to reduce coal purchases by 2 (tonnes).

2. We can follow the steps in the text to write and simplify the isocost line.

$$\begin{aligned} c &= wL + pR \\ 60 &= 10L + 5R \\ 5R &= 60 - 10L \\ R &= 12 - 2L \end{aligned}$$

3. If  $c = 30$ , the isocost line becomes  $R = 6 - 2L$  and if  $c = 90$ , the line becomes  $R = 18 - 2L$ . The graph looks as follows. Students should note, that only positive values of  $L$  are economically sensible, and that the new isocost lines are much steeper than under the previous relative prices.



## Marking guidance

Good answers would also include a short paragraph to explain the calculation.

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**Teaching ideas**

If this more technical material is discussed in the lecture, this is a very good exercise for an in-class 'think and compare with your neighbour' exercise. This way one can break up a long front-led lecture.

**EXERCISE 2.4 BRITAIN BUT NOT FRANCE**

Watch our video in which Bob Allen, an economic historian, explains his theory of why the Industrial Revolution occurred when and where it did.

1. Summarize Allen's claim using the concept of economic rents. Which *ceteris paribus* assumptions are you making?
2. What other important factors may explain the rise of energy-intensive technologies in Britain in the eighteenth century?

**Introduction**

The aim of this question is to recap the theory on why the Industrial Revolution happened in Britain and to think about other factors, which may have contributed to it.

**Answer**

Inventions like the Spinning Jenny were not new, but they were introduced between 1600 and 1700 because they were profitable investments in the UK. This is because female wages in the spinning industry had increased, which made capital-intensive production technologies more profitable in the UK than elsewhere. Figure 2.8 should be used to support this claim.

Capital-intensive production technologies were invented as labour costs were very high compared to energy costs. Allen suggests that the reason for these increased labour costs was economic expansion due to successful imperialism. Other reasons may be the abundance of coal in northern England. By switching to energy/capital-intensive technologies, innovation rents could be earned.

Basically, Allen takes all other country factors, which may encourage innovation, as given and constant. There is a wide debate about the role of other institutions which may have been important for the industrial revolution to happen in Britain and the extra reading in the chapter relates these other potential causes.

**Marking guidance**

Good answers first summarize Allen's claim and then reflect on other factors which have supported the industrial development. The concept of innovation rents should be clearly defined and explained and the answer should precisely link to the model proposed in the unit.

**Teaching ideas**

The aim is to train students to use the model above and to link it to Allen's narrative. Students should draw the relevant graphs in groups or at the board and make sure they present the narrative behind the model. This question may also be used for an extended project using the background reading given in the chapter.

- o Allen, Robert C, 2011. *Global Economic History: A Very Short Introduction*. New York, NY: Oxford University Press.
- o Allen, Robert C, 2001. 'The Great Divergence in European Wages and Prices from the Middle Ages to the First World War.' *Explorations in Economic History* 38 (4): 411–47.
- o Allen, Robert C, 2009. 'The Industrial Revolution in Miniature: The Spinning Jenny in Britain, France, and India.' *The Journal of Economic History* 69 (04): 901–27.
- o Allen, Robert C, 2008. *The British Industrial Revolution in Global Perspective*. Cambridge: Cambridge University Press.

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**EXERCISE 2.5 WHY DID THE INDUSTRIAL REVOLUTION NOT HAPPEN IN ASIA?**

Read David Landes' answer to this question (<http://tinyco.re/5958995>), and this summary of research on the great divergence (<http://tinyco.re/6223568>) to discuss why the Industrial Revolution happened in Europe rather than in Asia, and in Britain rather than in Continental Europe.

1. Which arguments do you find most persuasive, and why?
2. Which arguments do you find least persuasive, and why?

**Introduction**

The aim of this question is to explore explanations that are different from those provided by Allen in this unit and look for further factors that may have contributed to the Industrial Revolution or made some countries develop early, rather than later.

**Answer**

Institutions and country specific factors may have been important factors in the Industrial revolution. The two papers discuss this. Good answers summarize the claim made in both papers. They would distinguish between 'forerunner' and 'follower' characteristics of countries, and explain the diffusion process of the Industrial Revolution. One would also want to elaborate on the different political situations in the regions. The answers should carefully discuss the different points, and judge the likely importance of each of these factors.

- Landes, David S. 2006. 'Why Europe and the West? Why Not China?' *Journal of Economic Perspectives* 20 (2): 3–22.
- Mokyr, Joel. 2002. *The Gifts of Athena: Historical Origins of the Knowledge Economy*. Princeton, NJ: Princeton University Press.
- Pomeranz, Kenneth L. 2000. *The Great Divergence: China, Europe and the Making of the Modern World Economy*. Princeton, NJ: Princeton University Press.

**Marking guidance**

A good answer will present the argument closely referencing the text.

**Teaching ideas**

- Students could be split into two groups. One group presents the argument, the other group should criticize/evaluate it. Groups could alternate.
- This is also a good question for a research project where students' output could be a group poster.
- One could make this a small research project and refer to the large amount of literature focusing on the industrial revolution.
- It is also a good essay-type question for an assignment.

**EXERCISE 2.6 THE FARMERS' PRODUCTION FUNCTION**

In Unit 1 we explained that the economy is part of the biosphere. Think of farming biologically.

1. Find out how many calories a farmer burns, and how many calories are contained in 1 kg of grain.
2. Does farming produce a surplus of calories—more calories in the output than used up in the work input—using the production function in Figure 2.14b?

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### Introduction

The aim of this question is to incorporate the idea of biological feasibility into the argument. Students have to do some independent research on calorie consumption, as well as make assumptions about working time.

### Answer

- One first needs to research how many calories are burned in agricultural work. There are plenty of sources and students will only be able to approximate this. Calorie Lab (<http://tinyco.re/9625441>) for example, gives 476 calories per hour.
- The next information we need to know is grain production of a farmer per year. This depends on the number of farmers working on the land. The numbers are expressed as output at the end of the growing season, so we use this as yearly output. Let's assume we are at point B on the production function where the average product of the farmer is 458 kg per farmer.
- We also have to make assumptions on the standard working hours per year per farmer. Published research is (surprisingly) not definitive! For now, we assume that work towards grain production was 300 days a year, for 8 hours a day (students may find different estimates). Hence, 2,400 hours a year, which means that the average production per hour is roughly 0.2 kg grain/hour.
- We need to know how many calories are in 1 kg of grain. We have used 3151.4 calories, which means that per hour the farmer produces 630.28 calories.
- Based on these assumptions, grain production results in a net benefit.
- Finally, discuss the limitations of this calculation.

### Marking guidance

Good answers should be precise about where the information was sourced, and discuss the limitations of data sources.

### Teaching ideas

Students are not supplied with precise numerical data, so they need to reflect on assumptions and data quality. Teachers could ask students to present their estimates of the net benefit of grain production. The differences in outcomes can lead to a discussion about data choice, which could lead to a wider discussion on the challenges we face when we calibrate, estimate and simulate models.

### EXERCISE 2.7 ARE PEOPLE REALLY LIKE OTHER ANIMALS?

Malthus wrote: '[I]t is not to be supposed that the physical laws to which [mankind] is subjected should be essentially different from those which are observed to prevail in other parts of the animated nature.'

Do you agree? Explain your reasoning.

### Introduction

The aim of this question is to make students reflect on the difference between models in natural and social science. What are the similarities? What are the differences?

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**Answer**

Malthus is not entirely wrong. There are many similarities between humans and other animals. Humans need food to survive, we need nutrition to grow and flourish and we have life expectancies that are to a great extent dependent on the nutrition that they obtain. The key attribute that we share with other animals, according to Malthus, is that better nutrition will increase the probability of surviving to an age at which one can reproduce, and how many offspring (who also survive to reproductive age) one produces. This was true for most people for most of history, and still true in some of the world's poorest economies.

**Marking guidance**

A good answer will include:

- *A discussion of the sense in which other animals are similar to human life.* Need for food, nutrition and success in reproducing offspring. In the Malthusian model this link is important and students should explain this relationship to the model.
- *A discussion of in which ways humans and other animals differ.* Because of our ability to develop sophisticated language and our extraordinary learning abilities and cognitive capacities humans differ from most other animals many ways, among which is the scale on which we can cooperate and also the scale on which we wage wars (ants and other social insects also do these things on a grand scale).

**Teaching ideas**

This is a provocative statement and one could use this in a debate. One may want to ask students what the similarities and differences imply for economic modelling.

**EXERCISE 2.8 LIVING STANDARDS IN THE MALTHUSIAN WORLD**

Imagine that the population growth in Figure 2.16 (page 96) shifted to the left (with fewer people being born, or more people dying, at any level of wages). Explain what would happen to living standards describing the transition to the new equilibrium.

**Introduction**

With this exercise, students can practice the use of the graphical Malthusian model.

**Answer**

The change could be due to changes in fertility preferences or technology deterioration in public health. This change means that the subsistence wage is now higher. First, show what happens in a graph. Before the change, the economy is at a low wage / medium population equilibrium (point A). The red line in the right-hand panel shifts left, and now intersects the real wage line at a higher level. This is the new subsistence wage, that is, the wage that keeps population constant. Note that this change is permanent. Since the prevailing wage level is below subsistence, the population will begin to shrink. This will lead to a growth in wages, with the economy eventually reaching a new equilibrium point with higher wages and lower population (point B in the left-



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hand panel).

### Marking guidance

Good answers would draw the diagram correctly and explain the dynamic adjustment to a new equilibrium in this scenario carefully, using a lot of intuition.

### Teaching ideas

There are many ways to teach this material. In a small seminar the exercise could be discussed in groups or a student could talk the group through the argument at the whiteboard. The more formal discussion about the model could then progress into a discussion about what kind of policies would reduce population in this way.

### EXERCISE 2.9 WHAT WOULD YOU ADD?

The cause-and-effect diagram that we created in Figure 2.19 (page 99) made use of many *ceteris paribus* assumptions.

1. How does this model simplify reality?
2. What has been left out?
3. Try redrawing the figure to include other factors that you think are important.

### Introduction

The aim of this question is to further think about the mechanisms of the Malthusian model, as well as about the level of abstraction in models. It is a good question to initiate an open discussion about models from this unit but also about the historical regularities discussed here.

### Answer

The model simplifies reality by making several *ceteris paribus* assumptions: land is fixed, the only factors of production are land and labour and there is only one sector in the economy which is agriculture.

Other factors not included in the diagram are land quality, different sectors in the economy, possible migration from other places, and improved hygiene which would have caused the population to increase.

This is an invitation for students to try to construct their own model. They may add any of the above to the diagram and discuss their effect on rural income and wages.

### Marking guidance

There are many ways of amending the model. Good answers will use one addition at a time and clearly explain how it would affect the model mechanisms.

### Teaching ideas

Students could amend the model in Figure 2.16, draw in new relationships, and bring their new diagrams to class. They could pin them up on the wall and discuss the different model extensions in a poster presentation.

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This open-ended question invites students to think creatively about models and to amend simple economic models to include other important factors. The instructor may want to emphasize that, depending on the question asked, these extensions are necessary. At the same time, the abstract model may be able to explain the main forces present and may capture the main effects driving real wages in the data. The modeller faces a trade-off between abstraction and realism.

**EXERCISE 2.10** DEFINING ECONOMIC PROGRESS

Real wages also rose sharply following the Black Death in other places for which we have evidence, such as Spain, Italy, Egypt, the Balkans, and Constantinople (present-day Istanbul).

1. How does the growth of real wages compare with the growth of real GDP per capita as a measure of economic progress?
2. Try out your arguments on others. Do you agree or not? If you disagree, are there any facts that could resolve your disagreement, and what are they? If there are not, why do you disagree?

**Introduction**

The aim of this question is to differentiate GDP per capita measures and a measure, real wages, that is likely to be a better indicator of average living standards.

**Answer**

Neither is a very good measure, but they differ in the sense just mentioned.

**Marking guidance**

A good answer will define the real wage, summarize its evolution and carefully compare it to real GDP. Where are similarities? Where are differences? The main part of the question will focus on a discussion about which is the better measure to capture economic progress.

**Teaching ideas**

One could use the first part as a brainstorming exercise in a class or lecture. Students could discuss this in groups and share their answers. The more formal discussion about the indicators could then be led by the instructor.

Teachers could add a data exercise where real wages and GDP per capita data are compared. Students could produce a ranking of countries, towns or regions in terms of GDP and real wage measures and discuss differences in the ranking. For example, students might discover that real wages are higher in northern Europe than in the US, but GDP per capita is higher in the US than in most northern European economies.

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**EXERCISE 2.11 THE BASIC INSTITUTIONS OF CAPITALISM**

The escape from the Malthusian trap, in which technological progress outstripped the effects of population growth, took place following the emergence of capitalism. Consider the three basic institutions of capitalism in turn:

1. Why is private property important for technological progress to occur?
2. Explain how markets can provide both carrots and sticks to encourage innovation.
3. How can production in firms, rather than families, contribute to the growth of living standards?

**Introduction**

With this exercise students recap the institutions needed for capitalism to be successful, mentioned in the book.

**Answer**

Private property provides incentives for individuals and firms to invest in capital goods, increasing the productivity of labour, without fear that the returns from these investments will be appropriated by the state or other individuals.

Using new technology may enable a firm or entrepreneur to harvest economic rents. These rents are the 'carrot' which encourage innovation. On the other hand, if others adopt new technology, creative destruction means that a firm or entrepreneur that does not innovate may not be competitive and will therefore be pushed out of the market.

Production within families would make it impossible for a person with a new product, a new technology or a new way of organizing production to expand to occupy a major place in the economy. Firms by borrowing money from outsiders and hiring labour can expand if they are successful, spreading innovations throughout the economy.

**Marking guidance**

The exercise can be used in various ways. Independently from the extent of task, a good answer would focus on rents and creative destruction and apply it to the idea of innovation. Students may also link to the models discussed in the unit to clarify their answer.

**Teaching ideas**

The exercise lends itself to a group task. Students in small groups could discuss one of the above aspects and then present their answers.