Chapter 1
General introduction

1.1 Studying mathematics

The study of mathematics can be very rewarding. It is particularly satisfying to solve a problem and know that it is solved. Unlike many of the other subjects you will study, there is always a right answer in mathematics problems. Of course, part of the excitement of the social sciences arises from the fact that there may be no single 'right answer' to a problem: it is stimulating to participate in debate and discussion, to defend or re-think (and possibly change) your position.

It would be wrong to think that, in contrast, mathematics is very dry and mechanical. It can be as much of an art as a science. Although there may be only one right (final) answer, there could be a number of different ways of obtaining that answer, some more complex than others. Thus, a given problem will have only one 'answer', but many 'solutions' (by which we mean routes to finding the answer). Generally, a mathematician likes to find the simplest solution possible to a given problem, but that does not mean that any other solution is wrong. (There may be different, equally simple, solutions.)

With mathematical questions, you first have to work out precisely what it is that the question is asking, and then try to find a method (hopefully a nice, simple one) which will solve the problem. This second step involves some degree of creativity, especially at an advanced level. You must realise that you can hardly be expected to look at every mathematics problem and write down a beautiful and concise solution, leading to the correct answer, straight away. Of course, some problems are like this (for example, 'Calculate $2 + 2$'!), but for other types of problem you should not be afraid to try various different techniques, some of which may fail. In this sense, there is a certain amount of 'trial and error' in solving some mathematical problems. This really is the way a lot of mathematics is done. For obvious reasons, teachers, lecturers and textbooks rarely give that impression: they present the solution right there on the page or the blackboard, with no indication of the time a student might be expected to spend thinking — or of the dead-end paths he or she might understandably follow — before a solution can be found. It is a good idea to have scrap paper to work with so that you can try out various methods of solution. (It is very inhibiting only to have in front of you the crisp sheet of paper on which you want to write your final, elegant, solutions. Mathematics is **not** done that way.) You must not get frustrated if you can't solve a problem immediately. As you proceed through the subject, gathering more experience, you will develop a feel for which techniques are likely to be useful for particular problems. You should not be afraid to try different techniques, some of which may not work, if you cannot immediately recognise which technique to use.

1.2 Mathematics in the social sciences

Many students find mathematics difficult and are tempted to ask why they have to endure the agony and anguish of learning and understanding difficult mathematical concepts and techniques. Hopefully you will not feel this way, but if you do, be assured that all the techniques you struggle to learn in this subject will be useful in the end for their applications in economics, management, and many other disciplines. Some of these applications will be illustrated in this subject guide and in the textbooks. In fact, as the textbook discussions illustrate, far from making things difficult and complicated, mathematics makes problems in economics, management and related fields 'manageable'. It's not just about working out numbers; using mathematical models, **qualitative** — and not simply **quantitative** — results can be obtained.[1]

1.3 Aims and objectives

There is a certain amount of enjoyment to be derived from mathematics for its own sake. It is a beautiful subject, with its own concise, precise and powerful language. To many people, however, the main attraction of mathematics is its breadth of useful applications.

The main aim of this subject is to equip you with the mathematical tools for the study of economics, management, accounting, banking and related disciplines.

This half course may not be taken with **173 Algebra** or **174 Calculus**.

1.4 Learning outcomes

At the end of this half course and having completed the Essential reading and activities, you should have:

- used the concepts, terminology, methods and conventions covered in the half course to solve mathematical problems in this subject
- the ability to solve unseen mathematical problems involving understanding of these concepts and application of these methods
- seen how mathematical techniques can be used to solve problems in economics and related subjects.

1.5 How to use the subject guide

This subject guide is **absolutely not** a substitute for the textbooks. It is only what its name suggests: a guide to the study and reading you should undertake. In each of the subsequent chapters, brief discussions of the syllabus topics are presented, together with pointers to recommended readings from the textbooks. **It is essential that you use**

[1] See Anthony and Biggs (1996) Chapter 1, for instance.

textbooks. Generally, it is a good idea to read the texts as you work through a chapter of the guide.

It is most useful to read what the guide says about a particular topic, then do the necessary reading, then come back and re-read what the guide says to make sure you fully understand the topic. Textbooks are also an invaluable source of examples for you to attempt.

You should not necessarily spend the same amount of time on each chapter of the guide: some chapters cover much more material than others. I have divided the guide into chapters in order to group together topics on particular central themes, rather than to create units of equal length.

The discussions of some topics in this guide are rather more thorough than others. Often, this is not because those topics are more significant, but because the textbook treatments are not as extensive as they might be.

Within each chapter of the guide you will encounter 'Learning activities'. You should carry out these activities as you encounter them: they are designed to help you understand the topic under discussion. Solutions to them are at the end of the chapters, but do make a serious attempt at them before consulting the solutions.

To help your time management, the chapters and topics of the subject are converted below into **approximate** percentages of total time. However, this is purely for indicative purposes. Some of you will know the basics quite well and need to spend less time on the earlier material, while others might have to work hard to comprehend the very basic topics before proceeding onto the more advanced.

Chapter	Title	% Time
2	Basics	20
3	Differentiation	20
4	Integration	15
5	Functions of several variables	20
6	Matrices and linear equations	15
7	Sequences and series	10

At the end of each chapter, you will find a list of 'Learning outcomes'. This indicates what you should be able to do having studied the topics of that chapter. At the end of each chapter, there are 'Sample examination questions': some of these are really only samples of **parts** of exam questions.

1.6 Recommended books

The main recommended text is the book by Anthony and Biggs. This covers all of the required material and uses the same notations as this guide. But if you need more help with the material of the second chapter ('Basics'), you might find it useful to consult some other texts (such as the one by Booth), which treat this basic material more slowly.

1.6.1 Main text

☞ Anthony, M. and N. Biggs, *Mathematics for economics and finance*. (Cambridge, UK: Cambridge University Press, 1996) [ISBN 9780521559133].[2]

1.6.2 Other recommended texts

Please note that as long as you read the Essential reading you are then free to read around the subject area in any text, paper or online resource. To help you read extensively, you have free access to the VLE and University of London Online Library (see below). Other useful texts for this course include:

☞ Binmore, K. and J. Davies, *Calculus*. (Cambridge, UK: Cambridge University Press, 2001) [ISBN 9780521775410].

☞ Booth, D.J. *Foundation mathematics*. Harlow: Prentice Hall, 1998) Third Edition. [ISBN 9780201342949].

☞ Bradley, T. *Essential mathematics for economics and business*. (Chichester: Wiley, 2008) Third Edition. [ISBN 9780470018569].

☞ Dowling, Edward T. *Introduction to mathematical economics*. Schaum's Outline Series. (New York; London: McGraw-Hill, 2000) Third Edition. [ISBN 9780071358965].

☞ Ostaszewski, A. *Mathematics in economics: models and methods*. (Oxford, UK: Blackwell, 1993) [ISBN 9780631180562].

Each chapter of Anthony and Biggs has a large section of fully worked examples, and a selection of exercises for the reader to attempt.

The book by Binmore and Davies contains all the calculus you will need, and a lot more, although it is at times a bit more advanced than you will need.

If you find you have considerable difficulty with some of the earlier basic topics in this subject, then you should consult the book by Booth (or a similar one: there are many at that level). This book takes a slower-paced approach to these more basic topics. It would not be suitable as a main text, however, since it only covers the easier parts of the subject.

The book by Bradley covers most of the material, and has plenty of worked examples.

Dowling's book contains lots of worked examples. It is, however, less concerned with explaining the techniques. It would not be suitable as your main text, but it is a good source of additional examples.

Ostaszewski is at a slightly higher level than is needed for most of the subject, but it is very suitable for a number of the topics, and provides many examples.

There are many other books which cover the material of this subject, but those listed above are the ones I shall refer to explicitly.

Detailed reading references in this subject guide refer to the editions of the set textbooks listed above. New editions of one or more of these textbooks may have been published by the time you study this course. You can use a more recent edition of any

[2]Recommended for purchase.

of the books; use the detailed chapter and section headings and the index to identify relevant readings. Also check the virtual learning environment (VLE) regularly for updated guidance on readings.

It is important to understand how you should use the textbooks. As I mentioned above, there are no great debates in mathematics at this level: you should not, therefore, find yourself in passionate disagreement with a passage in a mathematics text! However, try not to find yourself in **passive agreement** with it either. It is so very easy to read a mathematics text and agree with it, **without engaging with it**. Always have a pen and scrap paper to hand, to make notes and to work through, for yourself, the examples an author presents. The single most important point to be made about learning mathematics is that, to learn it properly, you have to do it. **Do** work through the worked examples in a textbook and **do** attempt the exercises. This is the real way to learn mathematics. In the examination, you are hardly likely to encounter a question you have seen before, so you must have practised enough examples to ensure that you know your techniques well enough to be able to cope with new problems.

1.7 Online study resources

In addition to the subject guide and the Essential reading, it is crucial that you take advantage of the study resources that are available online for this course, including the VLE and the Online Library.

You can access the VLE, the Online Library and your University of London email account via the Student Portal at:

http://my.londoninternational.ac.uk

You should receive your login details in your study pack. If you have not, or you have forgotten your login details, please email uolia.support@london.ac.uk quoting your student number.

1.7.1 The VLE

The VLE, which complements this subject guide, has been designed to enhance your learning experience, providing additional support and a sense of community. It forms an important part of your study experience with the University of London and you should access it regularly.

The VLE provides a range of resources for EMFSS courses:

- Self-testing activities: Doing these allows you to test your own understanding of subject material.
- Electronic study materials: The printed materials that you receive from the University of London are available to download, including updated reading lists and references.
- Past examination papers and *Examiners' commentaries*: These provide advice on how each examination question might best be answered.
- A student discussion forum: This is an open space for you to discuss interests and experiences, seek support from your peers, work collaboratively to solve problems

and discuss subject material.
- Videos: There are recorded academic introductions to the subject, interviews and debates and, for some courses, audio-visual tutorials and conclusions.
- Recorded lectures: For some courses, where appropriate, the sessions from previous years' Study Weekends have been recorded and made available.
- Study skills: Expert advice on preparing for examinations and developing your digital literacy skills.
- Feedback forms.

Some of these resources are available for certain courses only, but we are expanding our provision all the time and you should check the VLE regularly for updates.

1.7.2 Making use of the Online Library

The Online Library contains a huge array of journal articles and other resources to help you read widely and extensively.

To access the majority of resources via the Online Library you will either need to use your University of London Student Portal login details, or you will be required to register and use an Athens login:

http://tinyurl.com/ollathens

The easiest way to locate relevant content and journal articles in the Online Library is to use the **Summon** search engine.

If you are having trouble finding an article listed in a reading list, try removing any punctuation from the title, such as single quotation marks, question marks and colons.

For further advice, please see the online help pages:

www.external.shl.lon.ac.uk/summon/about.php

1.8 Examination advice

Important the information and advice given here are based on the examination structure used at the time this guide was written. Please note that subject guides may be used for several years. Because of this we strongly advise you to always check both the current *Regulations* for relevant information about the examination, and the VLE where you should be advised of any forthcoming changes. You should also carefully check the rubric/instructions on the paper you actually sit and follow those instructions.

Remember, it is important to check the VLE for:

- up-to-date information on examination and assessment arrangements for this course
- where available, past examination papers and *Examiners' commentaries* for the course which give advice on how each question might best be answered.

A Sample examination paper may be found at the end of this subject guide. You will see that from 2009–10, all of the questions on the paper are compulsory. Any further changes to exam format will be announced on the VLE.

It is worth making a few comments about exam technique. Perhaps the most important, though obvious, point is that you do not have to answer the questions in any particular order; choose the order that suits you best. Some students will want to do easy questions first to boost their confidence, while others will prefer to get the difficult ones out of the way. It is entirely up to you.

Another point, often overlooked by students, is that you should **always** include your working. This means two things.

- First, do not simply write down your answer in the exam script, but explain your method of obtaining it (that is, what I called the 'solution' earlier).
- Secondly, include your rough working. You should do this for two reasons:
  - If you have just written down the answer without explaining how you obtained it, then you have not convinced the Examiner that you know the techniques, and it is the techniques that are important in this subject. (The Examiners want you to get the right answers, of course, but it is more important that you prove you know what you are doing: that is what is really being examined.)
  - If you have not completely solved a problem, you may still be awarded marks for a partial, incomplete, or slightly wrong, solution; if you have written down a wrong answer and nothing else, no marks can be awarded. (You may have carried out a lengthy calculation somewhere on scrap paper where you made a silly arithmetical error. Had you included this calculation in the exam answer book, you would probably not have been heavily penalised for the arithmetical error.) It is useful, also, to let the Examiner know what you are thinking. For example, if you know you have obtained the wrong answer to a problem, but you can't see how to correct it, say so!

As mentioned above, you will find that, wherever appropriate, there are sample exam questions at the end of the chapters. These are an indication of the types of question that might appear in future exams. But they are **just** an indication. The Examiners want to test that you know and understand a number of mathematical methods and, in setting an exam paper, they are trying to test whether you do indeed know the methods, understand them, and are able to use them, and not merely whether you vaguely remember them. Because of this, you will quite possibly encounter some questions in your exam which seem unfamiliar. Of course, you will only be examined on material in the syllabus. Furthermore, you should **not** assume that your exam will be almost identical to the previous year's: for instance, just because there was a question, or a part of a question, on a certain topic last year, you should not assume there will be one on the same topic this year. For this reason, you cannot guarantee passing if you have concentrated only on a very small fraction of the topics in the subject. This may all sound a bit harsh, but it has to be emphasised.

1.9 The use of calculators

You will not be permitted to use calculators of any type in the examination. This is not something that you should panic about: the Examiners are interested in assessing that

you understand the key methods and techniques, and will set questions which do not require the use of a calculator.

In this guide, I will perform some calculations for which a calculator would be needed, but you will not have to do this in the exam questions. Look carefully at the answers to the sample exam questions to see how to deal with calculations. For example, if the answer to a problem is $\sqrt{2}$, then leave the answer like that: there is no need to express this number as a decimal (for which one would need a calculator or a very good memory!).