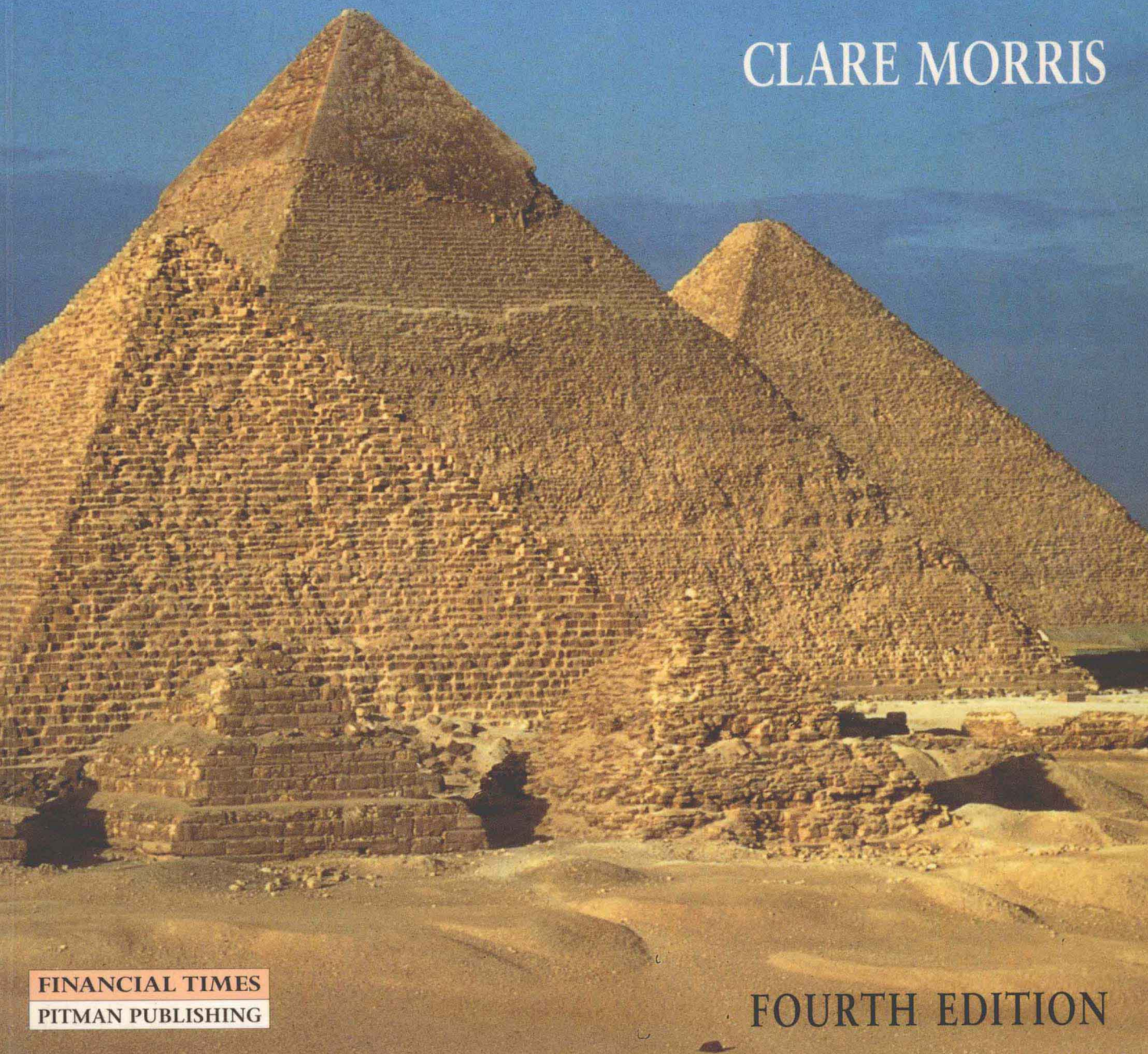
QUANTITATIVE APPROACHES IN BUSINESS STUDIES

CLARE MORRIS



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FOURTH EDITION

QUANTITATIVE APPROACHES IN BUSINESS STUDIES

Fourth edition

CLARE MORRIS

MA (Oxon), MSc, PhD (Bristol), C Stat
Warwick Business School, University of Warwick

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Tel: +44 (0)171 447 2000
Fax: +44 (0)171 240 5771
Website: www.ftmanagement.com

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PREFACE TO THE FOURTH EDITION

In a rapidly-changing educational environment, there is a need to revise texts with increasing frequency if they are to retain their currency, as witness to the fact that six years elapsed between the first and second editions of this book, four years between the second and third, but only three years between the third and this present edition. However, the major objective of that first edition remains unchanged; to recognise that most students studying quantitative methods as part of a business and management course are not mathematicians, never will be mathematicians, and have no wish to be mathematicians. At the same time, they undoubtedly have other skills – in problem-solving, communication, and business operations – which must be exploited by anyone attempting to interest them in a quantitative approach to business problems.

Accordingly, this book has a high proportion of words, and a correspondingly low proportion of numbers, mathematical symbolism, and jargon. Few proofs of results are given; instead, the effectiveness of the methods may be judged by whether they give sensible and useful solutions to practical problems. By adopting a problem-driven approach, I hope to convince students that quantitative methods, while not always easy to get to grips with, really do have something irreplaceable to offer as a tool of management.

The range of topics covered is probably larger than would be included in any single HND first-year degree course, or MBA programme, particularly as far as Part Four is concerned. The topics selected for any individual course will naturally reflect the interests of the lecturer and the specialist needs of the students involved. I have therefore tried to make the chapters of that Part as independent as possible of each other. Where there is a dependence on preceding material, the fact is indicated in the list of prerequisites at the start of the chapter. Further details about possible topic sequences will be found in the section. 'How this book is organised', on p. xii.

One major change which has taken place during the period since the publication of the third edition, and which is reflected in the current edition, is that EXCEL has become very widely used as the standard spreadsheet in industry; references to LOTUS 1-2-3 throughout the third edition have therefore been replaced by corresponding use of EXCEL, and the material on the associated disk has been changed to match. References to MINITAB now relate to version 10 for Windows. As in the third edition, material associated with the use of computer software is distinguished by the label C so that readers who wish to ignore it may conveniently do so.

The other most significant change is the introduction of an entire new chapter (Chapter 12) on Statistical Process Control. This has become probably *the* major way in which statistical methods impinge on management practice, not only in manufacturing but increasingly in the service sector. Feedback from lecturers who regularly adopt the book, and indeed from student users, also indicated that there was a definite demand for the inclusion of this material.

Inevitably in the course of a teaching career one's ideas as to how a particular topic should be approached will evolve, and on revisiting the chapter covering Correlation I found that I was no longer happy with the order and style in which the material was introduced. Accordingly this chapter has been completely rewritten to provide a stronger motivation for the Pearson correlation coefficient formula.

Other minor changes and updatings have been made throughout. Again in response to demand from readers, additional problems, both with and without worked solutions, have been included in most chapters. The opportunity has been taken to correct various errors and obscurities in the previous edition, and in this context I am grateful to numerous former members of the MBA programmes at Warwick Business School for making me aware of some of these problems. I also owe a particular debt of gratitude to Noel Petty, formerly of ICI Teesside, who read the entire third edition with a hawk-eyed attention to detail, not only revealing misprints which no-one else had spotted, but making numerous suggestions for modifications to the text which invariably resulted in improved clarity. I am grateful also to all other readers who have taken the trouble to inform me of errors and confusions they have come across; please continue to do so. Needless to say, any remaining errors are entirely my own responsibility.

Once again I am very greatly indebted to the many readers of the book, both students and colleagues, who have taken the trouble to inform me of errors and confusions they have encountered. Please continue to let me know of any which remain.

I am grateful to the Literary Executor of the late Sir Ronald A. Fisher, FRS, to Dr Frank Yates, FRS, and the Longman Group Ltd, London, for permission to reprint Tables IV and VII from their book *Statistical Tables for Biological, Agricultural and Medical Research* (6th edition, 1974). I would also like to thank Macmillan, London and Basingstoke, for permission to use part of Tables 1 and 2, and Tables 3 and 7, from *Statistical Tables* by J. Murdoch and J. A. Barnes; the Biometrika Trustees for permission to use material from Table 8 of *Biometrika Tables for Statisticians,* vol. I (3rd edition, 1966), and to the Controller of Her Majesty's Stationery Office for permission to reproduce Fig. 3.1 from the *Monthly Digest of Statistics*.

I would like to thank Minitab, Inc., 3081 Enterprise Drive, State College, PA 16081, USA (Telephone 814/238–3280, Telex 881612) for their co-operation in supplying material relating to their Statistical Software. Likewise I am indebted to Microsoft Corporation for permission to make reference to Microsoft Excel, and to use material generated by the use of this software. Both Minitab and Microsoft are registered trade names.

Finally, I am profoundly indebted to Simon Lake and Julianne Mulholland at Financial Times Management, for their support in the production of this edition, and most particularly for their patience and understanding when schedules began to slip!

Clare Morris
March 1996

An *Instructor's Manual* is available to lecturers adopting this textbook.

NOTE TO THE READER

Although I hope that you're going to find this book fairly readable, it would be silly to pretend that you can read it – or any other textbook on a numerical subject – in quite the same way as you would read, say, a detective story, or even a textbook in a more 'wordy' subject such as law or sociology. Since I naturally want you to benefit as much as possible from reading this book, and since it may be some time since you last studied a numerical subject, you may find the following points helpful.

At the start of each chapter you will find a list of the prerequisites for reading that chapter – the things which you need to understand in order to follow the material contained in the chapter. If you are doubtful about any of these, go back to the section in which the topic was covered (you'll find a reference given) and check your understanding of that topic. *Don't* just carry on into the chapter hoping for the best – that's the way to get confused and demoralised! To a large extent mathematics and statistics are cumulative subjects, in which one topic builds on another, so it's important to get each stage clear before going on to the next.

You will also find at the start of the chapters a list of the things which you should be able to do by the end of the chapter; when you've read the chapter, and gone through some of the exercises at the end – particularly the more straightforward problems – then waited a few days for the material to fall into place, you can use this list to check that you've grasped the main points of the chapter. You may also find that these lists are useful when you come to revise for examinations, in reminding you of the major areas within each topic.

Always have a pencil and paper to hand when you are reading the book, so that you can follow the workings of problems for yourself, or perhaps work out in more detail steps of a calculation which I have abbreviated. And don't worry too much if you feel you haven't grasped every single idea in a section immediately – most people find that numerical ideas may take two or three readings, plus some work on practical examples, before they make complete sense.

Finally, and most importantly, remember that all the skills which you bring to bear in other areas of your work – your ability to communicate effectively, your knowledge of business, your problem-solving skills, and above all your plain common sense can be used in the numerical context too. Is this a sensible result? Is it about the size of answer which I would have expected to get? Is it realistic in terms of the original problem we set out to solve? – these are the kinds of questions you should constantly be asking yourself as you work through the book, so that by the end numbers, and the ability to handle them effectively, will be just another of your everyday skills.

How this book is organised

Although most of the topics covered in this book appear in many courses on Quantitative Methods for business and management, you may find that your course does not include all of them. Or perhaps you are reading the book for interest only, and would like to be able to skip some material without getting lost.

For your guidance, here is an indication of how the book fits together, and of possible routes through it. You will find more detailed information about the prerequisites for understanding each chapter at the start of the chapter. The order in which topics are covered is to some extent a matter of taste; I have tried to provide a logical structure by subdividing the book into four parts, but there are many other possible and equally logical orders which you could follow.

Chapter 1 is necessary only if you are not very confident of your basic mathematical skills; try the test at the start to find out if you have the level of ability needed for later work.

Chapter 2 is necessary for those of you who will be using either MINITAB or EXCEL software as an adjunct to your work with this book. Even if you will not be doing so, you may still wish to skim through this chapter to find out what the software has to offer.

Chapters 3–6 should be read sequentially, and cover the essentials for what is called Descriptive Statistics.

Chapter 7 on index numbers could be omitted without affecting later work.

Chapters 8–12 are also sequential; they cover probability and the problems of drawing conclusions from samples, and could be left out if you are only interested in the descriptive aspects of the subject. Chapter 12 on Quality Control could be omitted if you are not interested in this area of application.

Chapters 13 and 14 are chiefly devoted to correlation and regression, very important topics which are widely used in many business problems. They do not require you to have read Chapters 8–12.

Chapter 15 covers the topic of forecasting, again a very important area of interest for business applications. This chapter does not depend on previous work, and could be read much earlier in the sequence if you wish.

Chapters 16–20 are each devoted to a separate topic in Operational Research, and each is pretty well free-standing, except that Chapter 20 needs some of the material on distributions covered in Chapters 6 and 9.

CONTENTS

PART 1

NUMBERS – HOW WE HANDLE THEM

This Part covers the essential tools which you will need to use in order to get the most out of your reading of the rest of the book. Chapter 1 summarises the mathematical methods required, with material to help you revise and improve your understanding of these methods if necessary, and exercises to help you discover if you have done so satisfactorily. Chapter 2 introduces the optional diskette which accompanies this book, and the two software packages – MINITAB and EXCEL – with which the diskette may be used.

Chapter 1

TOOLS OF THE TRADE: BASIC NUMERACY SKILLS

Chapter prerequisites

Before starting work on this chapter, try the short test of basic mathematical skills in this section; you will find the answers are given in Appendix 9 and, according to which questions you find difficult, you will be directed to the appropriate section of this chapter. This will save you time and prevent your having to read through a lot of things which in fact you can already cope with. If, however, you get more than half of the test questions wrong I would advise you to read the entire chapter.

Chapter objectives

By the end of your work on this chapter you should be able to:

1. carry out the four operations of basic arithmetic (addition, subtraction, multiplication and division) with positive and negative integers, fractions and decimals;
2. round off the results of your calculations to a given number of decimal places or significant figures;
3. perform calculations involving percentages;
4. handle expressions involving powers and roots of a variable;
5. remove brackets from algebraic expressions;
6. construct a linear equation or inequality from a verbal problem;
7. solve linear equations;
8. solve a pair of simultaneous equations;
9. plot the graphs of linear equations or inequalities;
10. make efficient use of your calculator.

TEST

1 $-3 + 4 =$ 2 $-5 \div 2 =$ 3 $\frac{3}{8} + \frac{4}{5} =$ 4 $\frac{7}{8} \times \frac{3}{5} =$

5 $2 \div \frac{1}{2} =$ 6 $0.05 \times 2.5 =$ 7 $8 \div 0.2 =$

8 Convert $\frac{5}{12}$ to a decimal.

9 Express 0.28 as a fraction.

10 What is 67.469 to 3 significant figures?

11 16% of 8 = 12 18 as a percentage of 64 =

13 The price of an item including the dealer's 20% mark-up is £36. What did it cost before the mark-up?

14 $x^2 \times x^4 =$ 15 $\sqrt{x^{16}} =$

16 $2(3a + b) - (a - 2b) =$

17 If it costs £6 to drive k miles then what is the cost of driving 4 miles?

18 Items priced at m pence per dozen are repacked in boxes of 100. What will the cost of such a box be, in pounds?

19 There are f female workers and m male workers in a factory. Write down an algebraic expression to show that the total work-force must be less than 150.

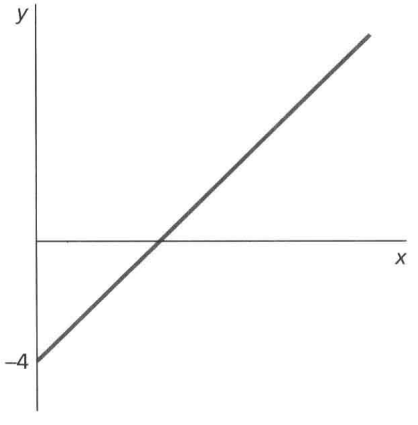
20 $3x - 5 = 10$; $x =$ 21 $\frac{4}{y} = \frac{7}{8}$; $y =$

22 $\begin{cases} 3p + 2q = 9 \\ 4p - 6q = 25 \end{cases}$ Find p and q.

23 Where does the graph of $s = 3t + 5$ cross the t-axis?

24 Which of these graphs, (*a*), (*b*) or (*c*), could be the graph of $y = x^2 + 3x - 4$?

(a)



(b)