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978-0-521-08955-5 - Mathematical Modelling: A Case Study Approach

Dick Clements

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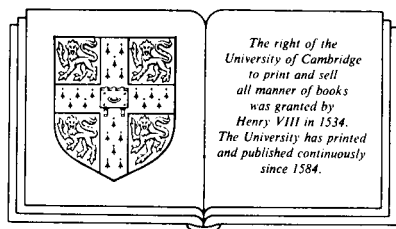
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Dick Clements

University of Bristol



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Preface

In 1973, when I joined the staff of the University of Bristol as a lecturer in the Department of Engineering Mathematics, I found my new colleagues in the preliminary stages of planning a novel degree course to be known as Engineering Mathematics. One of the primary objectives of this degree course was to produce graduates with not only a sound mathematical education but also the ability to apply their mathematical knowledge to the solution of the problems of commerce and manufacturing industry. As a contribution to the design of this course I proposed to my colleagues that we should include, in the overall course structure, a course of practical mathematical activities aimed at introducing students to a range of industrially relevant mathematical and para-mathematical activities. Thus was born the Case Study course.

The concept of the course called for the collection of resource material from a wide cross-section of industry and commerce. To support this phase of the work a grant was sought from the Nuffield Foundation under what was then known as their Small Grants Scheme for Undergraduate Teaching. The grant was approved and the task of gaining the co-operation of industry and commerce in the creation of the resource material for the course proceeded throughout 1976 and 1977. The course itself was first used with undergraduate students in early 1978 and has been run annually since then. It has become one of the distinctive features of the Engineering Mathematics course and is, incidentally, highly popular with the students.

This book is divided into two sections. Part I (Chapters 1 to 4) introduces the topic of mathematical modelling and places it in its context *vis-à-vis* the Case Study course. It is my opinion that an ability to create and use mathematical models is an essential skill for an effective user of mathematics in the industrial or commercial context. That alone does not, however, suffice. There are a range of other mathematical and para-mathematical abilities which are also needed. Not least amongst these is the ability to communicate mathematical ideas both to other mathematicians and to those with less mathematical skill or inclination. The Case Study method aims not only to teach a modicum of mathematical modelling but also to develop these other skills.

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Part II (Chapters 5 onward) introduces a number of the individual case studies which have been used in the Case Study course. Each of these chapters is divided into three sections consisting of, respectively, the source material which is used to present the case study to the students, an outline of the work done by the staff of the company or institution in which the problem originally arose, and some comments about the methods which nine generations of students have used to 'solve' the problems.

There are many individuals and corporate bodies without whose goodwill and assistance this course would not have existed and this book would not have been written. My thanks must, naturally, go firstly to the Nuffield Foundation, without whose support the creation of the course would not have been possible. Thanks are also due to my colleagues in the Engineering Mathematics Department, particularly to Prof Ronald Milne for his continual and continuing encouragement, help and advice, and to Dr Bruce Pilsworth, who has, since 1983, shared in the running of the course. To these I must add all my friends and colleagues in Universities, Polytechnics, and equivalent institutions in many parts of the world who have shown, through their enthusiastic discussion of this work and in myriad other ways, their interest and encouragement. My gratitude is also due to the 'victims', the students of Engineering Mathematics at Bristol over the years, for their (in most cases) ready acceptance of an unusual and novel learning experience and their eventual enthusiasm for the medium and delight in their newly acquired skills, and to Louise Clements, who assisted in the administration of the resource collection phase of the project during 1976 and 1977.

I must also thank the Military Aircraft Division of British Aerospace plc at Warton, British Gas plc, Courtaulds plc, The Marconi Research Centre of GEC Research Limited, Mirrlees Blackstone (Stockport) Limited and a number of other companies who have generously contributed to the course and given their permission for the material provided to be included in this book. In particular I am most grateful to those employees of the aforementioned companies through whose agency I received the companies' assistance. I thank them for their cheerful helpfulness and the tolerance with which they endured my persistent enquiries. Finally my thanks go to my colleague and friend Margaret Irish for the interest, encouragement and tolerance she has shown during the writing of this book.

April 1988

DICK CLEMENTS