

## *Preface*

This book is intended for both undergraduate students and their staff as a guide to individual projects, group projects and case studies in mathematics. It covers all aspects of setting up projects and their assessment. The bulk of the text is devoted to giving worked examples of the various kinds of project. The author has benefited from a dual career first in an engineering department where he spent eight years which included looking after individual and group projects, often of a very practical nature. For the last twenty years, he has been within mathematics but still supervising different kinds of projects. This book is therefore written largely from experience. Mathematics here excludes statistics and operational research.

In the last few years there has been pressure on all undergraduate courses to include student centred learning. In mathematics this is difficult because most of the curriculum is devoted to learning mathematical skills. These skills are invariably assessed by examination as it is only in the controlled environment of an examination that the assessors can be sure who is being assessed. One does not assess skills such as spelling or piano grades by setting coursework or projects, hence many would ask how can you assess mathematics other than by a closed book examination? My reasoning is that with the increase in access the nature of many mathematics degrees has changed. If mathematics as a discipline is to keep pace with other undergraduate subjects it has to include modules that enable the student to develop in the broad sense. This means students must have the opportunity to work by themselves on a mathematical topic, or the opportunity to work with three or four other students towards a common goal. It is recognised that this must not be compulsory as there must be room for the clever student who has mathematical flair and may go on to a Fields Medal. This is the mathematics equivalent to the Nobel Prize. Incidentally there is a story that there is only no Nobel Prize in mathematics because

Alfred Nobel's wife eloped with a mathematician! As Nobel never married, the story cannot be true. However, perhaps he lost out in love to a mathematician. It is also said that Nobel had an intense personal dislike of the Swedish mathematician Gösta Mittag-Leffler who was attractive to the ladies and would have been the obvious candidate for the Nobel prize in Mathematics. Whatever the truth, it is a sad omission but as it happens many who have graduated in mathematics have gained a Nobel Prize—Paul Dirac (Physics 1933), Bertrand Russell (Literature 1950) and Richard Feynman (Physics 1965) to name but three.

These days mathematics must not be seen as an elitist subject only to be taken by specialists, but as a useful subject which many can benefit from studying. The usefulness of mathematics should be obvious to scientists, engineers and economists particularly as even the softer areas of these subjects become more quantitative, but its service as a basic discipline that aids the underlying thought processes needs emphasising too. Mathematics graduates have gone on to be politicians and lawyers as well as to succeed in the creative arts. The cry of “what use is Pure Mathematics” should be ignored; who in their right mind questions the use of music, literature or fine art? Mathematics has always been the most transferable of skills, but mathematicians have not traditionally been exposed to project work and group work as undergraduates. Traditionally, the mathematics undergraduate has had no forum in which they can discuss approaches to a problem with fellow students, or to voice their own opinions. This is no longer acceptable, and this text will help both students and lecturers see how projects and case studies can work well in mathematics.

In the text, there are passages that are verbatim extracts from student projects. These are indented and in a smaller font. In other places, the text may state that the following “was done in the project” or some such phrase. In these instances, the author has not copied the student's work but has used the same mathematical method or proof so that the reader understands how the student has approached a particular piece of mathematics. In all cases the author would like to thank all the students who have contributed projects and group work to this text, particularly those who he has supervised. Their anonymity has been preserved although they will easily recognise their own projects one hopes. Three individual projects have been included in their entirety in three separate appendices. Heartfelt thanks go to the three students concerned for permitting this, especially those for whom the project experience was less than ideal. The prime purpose of this text is to learn from the examples of others and to encourage students to try projects and case studies. One can often learn much from reading the works of other students, so these examples are very valuable. For the record, these projects have been faithfully reproduced as closely as possible from the originals. This means that the figures were scanned in and

therefore deliberately do not match the usual high standards of Springer-Verlag. On the other hand, the use of  $\text{\LaTeX}$  has beautified the look of the mathematics, if not its content!

Thanks also go to the staff of the Mathematics and Statistics Department at the University of Plymouth. Many of the ideas, particularly those on assessment come from them. I thank those publishers who have permitted me to use figures from their books. Finally a big thank you to Noel Ford who drew all the cartoons to my sometimes less than well formed ideas.

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