Preface

The first twelve chapters of this textbook are based on a first-year undergraduate course at Anglia Ruskin University of the same name, the introduction of which represented a paradigm shift in the teaching of statistics to biologists. We moved from a maths-centred approach to a 'by-biologists-for-biologists' approach. Building confidence and motivation, as well as knowledge and skill became explicit aims. It worked—failure rates plummeted, while understanding and interest blossomed. We have since extended this approach to introduce the generalized linear model to our second and third years and this material is the source of Chapters 13 and 14.

The 'Choosing Chapter' has been moved forward in this fourth edition and is now Chapter 5 at the start of the chapters focusing on null hypothesis significance testing (NHST). This change was made in response to reviewer feedback but is consistent with my experience that it works well to at least start introducing the choosing chart of tests at this point in the *Biomeasurement* course. It has also allowed me to substantially revise the content, including giving me the opportunity to add a choosing chart for graphs and talk more about the uses of graphs. Since graphs are useful for exploring data and the checking of test assumptions, this further fits with the new location of this chapter. The other aspect I like about moving this chapter forward is that it helps use of the key concepts from Chapters 1–4 and can be used as a vehicle to review this material and consolidate learning.

While *Biomeasurement* explains how to carry out techniques and why they are needed, it does not explain how the underlying maths work. Mathematicians often disapprove of this approach. To them I say that unless you start with this approach, you will recruit very few biologists to the study of statistics, and biology desperately needs such sons and daughters. With *Biomeasurement* I hope to leave young scientists chomping at the bit for more—both wanting and able to read more mathematically orientated texts. It might not seem like it to them at first, but actually I am on the mathematicians' side.

Aim and audience

This is a textbook for the statistically challenged or uninitiated bioscientist. Aimed primarily at first-year undergraduates, this book is about building motivation and confidence as well as ability. Philosophical underpinnings are mixed with simple 'recipes' for descriptive and inferential statistics. This gives the reader a firm grounding in why statistics are needed and how to choose and carry out a range of the most useful and widely used techniques. While this book may well be initially read from cover to cover as a companion to a taught course or self-teaching aid, I hope it will stay on the reader's bookshelf as a well-used and familiar source of reference for many years. Certainly, I have noticed that even quite experienced researchers find this type of material useful to dip into from time to time.

Scope and style

This book is a broadly bioscience-based introductory text with examples coming from biomedicine, genetics, cell biology, biochemistry, behaviour, ecology, and conservation. The techniques covered span all the topics that the majority of readers will encounter during their degree course. For some it may see them through their entire careers. It is my hope that all readers will complete this text with the confidence to be better able to tackle more advanced texts, or to ask a statistician for help and have the insight required to understand the answer.

The style is deliberately relaxed, leading the reader through a series of statistical facts, concepts, and procedures in an unintimidating style. The book contains mathematical formulae and shows how they are used but avoids explanations of how they are derived. It's like driving a car: knowing what a car looks like, how to drive it, and why that might be useful is all that's needed. Being able to explain how the internal combustion engine works is not essential. The driver has faith that the mechanic behind the system did his or her job well. Similarly, biologists don't need to understand the mathematical principles behind statistical equations to be good scientists. They merely need faith in the mathematicians who created the statistical formulae. If after studying this book the reader wants to find out more about the maths, that would be wonderful, but it's not essential to their becoming a successful bioscientist.

Associated projects

Biomeasurement, both the course and the book, has led to two associated Higher Education Academy (HEA) funded projects. Funding from the HEA Centre for Biosciences enabled the development of a departmental web-based resource centre to support the teaching and learning of all numerical techniques, including statistics. This project, known as NuMBerS (Numeric Methods for Bioscience Students) can be accessed at <http://web.anglia.ac.uk/numbers/>. In turn this spawned associated projects called SUMS (Students Upgrading Maths Skills) and NUMBAT (<http://numeracy-bank.net/>) funded by JISC, the UK Open Educational Resources Programme (UKOER), and the Higher Education Academy (HEA). These projects aim to identify teaching and learning challenges which are underpinned by weaknesses in student numeracy skills throughout Higher Education and to explore ways in which these challenges might be overcome. For more information on NUMBAT and SUMS, contact Toby Carter (Toby.Carter@anglia.ac.uk).

In June 2012, Jenny Koenig and I launched the Biomaths Education Network (<http://biomathed.wordpress.com/>). As a special interest group of the HEA it is targeted at the teacher rather than the student. Its purpose is to bring together all those interested in maths and stats education within the biosciences, from school through undergraduate degree programmes to postgrads and scientists working in industry.