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Statistics Explained

An Introductory Guide for Life Scientists

Second Edition

An understanding of statistics and experimental design is essential for life science studies, but many students lack a mathematical background and some even dread taking an introductory statistics course. Using a refreshingly clear and encouraging reader-friendly approach, this book helps students understand how to choose, carry out, interpret and report the results of complex statistical analyses, critically evaluate the design of experiments and proceed to more advanced material.

Taking a straightforward conceptual approach, it is specifically designed to foster understanding, demystify difficult concepts and encourage the unsure. Even complex topics are explained clearly, using a pictorial approach with a minimum of formulae and terminology. Examples of tests included throughout are kept simple by using small data sets. In addition, end-of-chapter exercises, new to this edition, allow self-testing. Handy diagnostic tables help students choose the right test for their work and remain a useful refresher tool for postgraduates.

Steve McKillup is an Associate Professor of Biology in the School of Medical and Applied Sciences at Central Queensland University, Rockhampton. He has received several tertiary teaching awards, including the Vice-Chancellor's Award for Quality Teaching and a 2008 Australian Learning and Teaching Council citation 'For developing a highly successful method of teaching complex physiological and statistical concepts, and embodying that method in an innovative international textbook'. He is the author of *Geostatistics Explained: An Introductory Guide for Earth Scientists* (Cambridge, 2010).

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Preface

If you mention 'statistics' or 'biostatistics' to life scientists, they often look nervous. Many fear or dislike mathematics, but an understanding of statistics and experimental design is essential for graduates, postgraduates and researchers in the biological, biochemical, health and human movement sciences.

Since this understanding is so important, life science students are usually made to take some compulsory undergraduate statistics courses. Nevertheless, I found that a lot of graduates (and postgraduates) were unsure about designing experiments and had difficulty knowing which statistical test to use (and which ones not to!) when analysing their results. Some even told me they had found statistics courses 'boring, irrelevant and hard to understand'.

It seemed there was a problem with the way many introductory biostatistics courses were presented, which was making students disinterested and preventing them from understanding the concepts needed to progress to higher-level courses and more complex statistical applications. There seemed to be two major reasons for this problem and as a student I encountered both.

First, a lot of statistics textbooks take a mathematical approach and often launch into considerable detail and pages of daunting looking formulae without any straightforward explanation about what statistical testing really does.

Second, introductory biostatistics courses are often taught in a way that does not cater for life science students, who may lack a strong mathematical background.

When I started teaching at Central Queensland University, I thought there had to be a better way of introducing essential concepts of biostatistics and experimental design. It had to start from first principles and develop an understanding that could be applied to all statistical tests. It had to demystify what these tests actually did and explain them with a minimum of formulae and terminology. It had to relate statistical concepts to experimental design. And, finally, it had to build a strong understanding to help the student progress to more complex material. I tried this approach with

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my undergraduate classes and the response from a lot of students, including some postgraduates who sat in on the course, was 'Hey Steve, you should write an introductory stats book!'

Ward Cooper suggested I submit a proposal for this sort of book to Cambridge University Press. The reviewers of the initial proposal and the subsequent manuscript made most appropriate suggestions for improvement. Ruth McKillup read, commented on and reread several drafts, provided constant encouragement and tolerated my absent mindedness. My students, especially Steve Dunbar, Kevin Strychar and Glenn Druery encouraged me to start writing and my friends and colleagues, especially Dearne Mayer and Sandy Dalton, encouraged me to finish.

I sincerely thank the users and reviewers of the first edition for their comments and encouragement. Katrina Halliday from CUP suggested an expanded second edition. Ruth McKillup remained a tolerant, pragmatic, constructive and encouraging critic, despite having read many drafts many times. The students in my 2010 undergraduate statistics class, especially Deborah Fisher, Michael Rose and Tara Monks, gave feedback on many of the explanations developed for this edition; their company and cynical humour were a refreshing antidote.

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