Preface

Getting the most out of this book

We write this section with some uncertainty since we rarely read a preface in a book and wonder if anyone is going to read what we've written here. Nonetheless, there are several important things we need to explain to you to enable you to get the best out of this book and its Online Resource Centre, so we'd encourage you to take a few moments to read on.

Who should read this book?

This book is primarily written for undergraduates who wish to develop their understanding of designing, carrying out, and reporting research. We anticipate that graduates, although familiar with most of this material, will find this book and its Online Resource Centre to be a useful reference tool. We have therefore used examples almost entirely drawn from real undergraduate and some graduate research projects. We are indebted to all our students who have allowed us to use their ideas and data in this book.

Content

The content is designed to take you through all the steps you need to follow when choosing, planning, evaluating, and reporting undergraduate research. The content is therefore laid out in a number of sections:

How to choose a suitable topic for undergraduate research (Appendix A)

Section 1: Planning an experiment (Chapters 1–4)

Section 2: Handling your data (Chapters 5–11)

Section 3: Reporting your results (Chapter 12)

In addition, in the appendices, we have included an explanation of the mathematical processes used in the chapters (Appendix B) and a quick guide to the correct statistical test to test hypotheses (Appendix C).

There is a close and essential link between planning research and understanding how statistics fit into this process. We have demonstrated these links in Section 1 by cross references to content in Section 2. In Section 2 we have highlighted the design elements that affect the data analysis and discuss how to overcome shortcomings in experimental designs.

Getting started

You may be coming to this book with very little in the way of training in mathematics. If you do not know how to calculate this sum $(4 \times 3)^2/2$, or if you do not recognize the symbols $<$ or $>$, then we suggest you first look at Appendix B and the additional examples on the Online Resource Centre.

You may wish to analyse data you have gathered from an experiment carried out in your course. For this we suggest you start with Chapter 7, which will then direct you to the correct sections in Chapters 8 to 11.

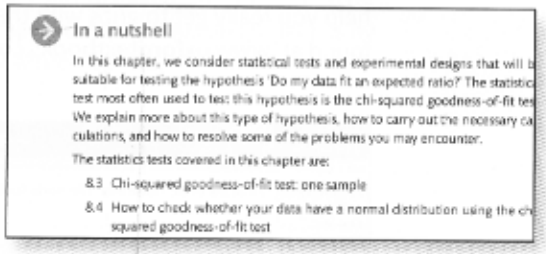
You may wish to prepare a critique of published research. The chapters that primarily consider this are Chapters 2 and 7.

If you wish to design a research project and you are familiar with terms such as variable, parametric, aim, hypothesis, etc., then you can start with Appendix A and Chapter 2. If you are not familiar with these terms still refer to Appendix A, and then continue from Chapter 1.

Learning features

Sign posts

There are a number of ways we have tried to help you quickly find the information you need. We have included an overview ('In a nutshell') and summary in each chapter and we have included a number of cross references providing links between related content.



In a nutshell

In this chapter, we consider statistical tests and experimental designs that will b
suitable for testing the hypothesis 'Do my data fit an expected ratio?' The statistic
test most often used to test this hypothesis is the chi-squared goodness-of-fit te
We explain more about this type of hypothesis, how to carry out the necessary ca
culations, and how to resolve some of the problems you may encounter.

The statistics tests covered in this chapter are:

8.3 Chi-squared goodness-of-fit test: one sample

8.4 How to check whether your data have a normal distribution using the ch
squared goodness-of-fit test

Key terms

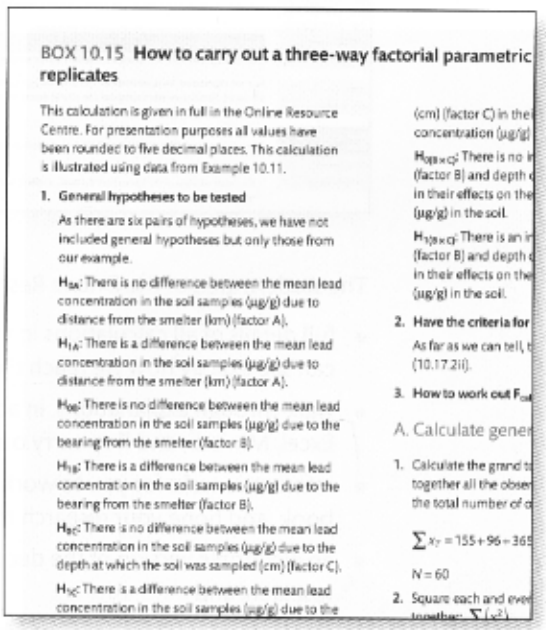
We know that most people will dip into this book and so we have included a glossary of most terms that you need to be familiar with towards the end. Definitions are placed in the margins in the chapters in which the terms are first used.

Boxes

In our experience we have found that students best understand the statistics element of this book if they first use a calculator to work out the calculation. Therefore we have arranged the statistical information in boxes with general details and a worked example for you to follow.

In the calculations we've included in this book we have rounded all values, usually to five decimal places. However, we carried out all the calculations using all decimal places (as you should). This means that some of our sums do not appear to quite add up. Any minor differences in the calculations as presented here should be the result of this rounding of values.

In the boxes some of the mathematical steps have not been included. We have therefore included the full calculations in the Online Resource Centre. We have also included an explanation of how to use SPSS, Excel, Minitab, and R to carry out the same calculations in the Online Resource Centre.



BOX 10.15 **How to carry out a three-way factorial parametric replicates**

This calculation is given in full in the Online Resource Centre. For presentation purposes all values have been rounded to five decimal places. This calculation is illustrated using data from Example 10.11.

1. **General hypotheses to be tested**

As there are six pairs of hypotheses, we have not included general hypotheses but only those from our example.

H_{0A}: There is no difference between the mean lead concentration in the soil samples (μg/g) due to distance from the smelter (km) (factor A).

H_{1A}: There is a difference between the mean lead concentration in the soil samples (μg/g) due to distance from the smelter (km) (factor A).

H_{0B}: There is no difference between the mean lead concentration in the soil samples (μg/g) due to the bearing from the smelter (factor B).

H_{1B}: There is a difference between the mean lead concentration in the soil samples (μg/g) due to the bearing from the smelter (factor B).

H_{0C}: There is no difference between the mean lead concentration in the soil samples (μg/g) due to the depth at which the soil was sampled (cm) (factor C).

H_{1C}: There is a difference between the mean lead concentration in the soil samples (μg/g) due to the

(cm) (factor C) in the
concentration (μg/g)

$H_{0(B\times C)}$: There is no i
(factor B) and depth
in their effects on the
(μg/g) in the soil.

$H_{1(B\times C)}$: There is an i
(factor B) and depth
in their effects on the
(μg/g) in the soil.

2. **Have the criteria for**

As far as we can tell,
(10.17.2ii).

3. **How to work out F_{cal}**

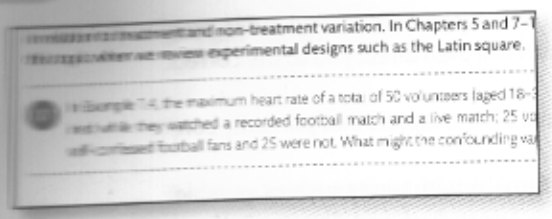
A. Calculate gene

1. Calculate the grand
together all the obse
the total number of

$\sum x_T = 155+96=365$

$N = 60$

2. Square each and eve
together: $\sum(x^2)$

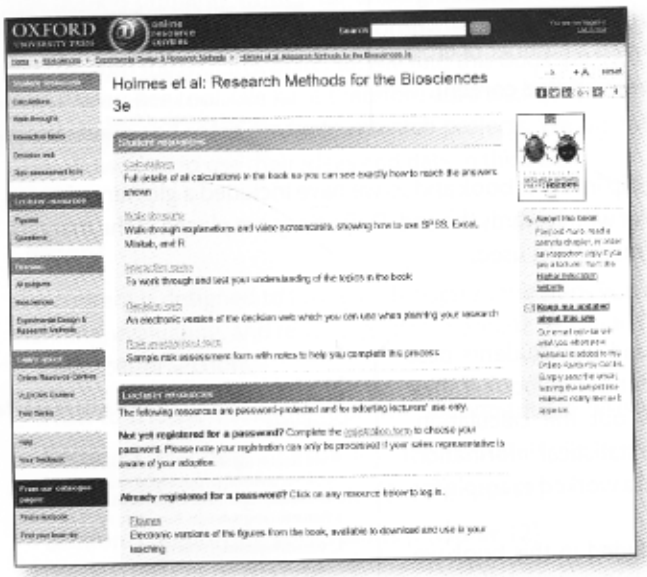


Questions

To help you check your understanding of the topics covered by this book we have included a number of questions. The answers are provided at the end of each chapter. More questions are included in the Online Resource Centre.

Online Resource Centre

Research Methods for the Biosciences is more than just this printed book. The *Research Methods for the Biosciences* Online Resource Centre features extensive online materials to help you really get to grips with the skills you need to carry out research work. This can be found at: www.oxfordtextbooks.co.uk/orc/holmes3e/



The student area of the Online Resource Centre includes:

- full details of all calculations in this book: every step in each calculation is shown so you can see exactly how we reach the answers shown in the book;
- walk-through explanations, in addition to video screencasts, showing how to use SPSS, Excel, Minitab, and R to carry out these calculations
- interactive tasks for you to work through to test your understanding of the topics in this book, and hone your research methods skills;
- an electronic version of the decision web which you can use when planning your research; and
- an electronic risk assessment which may be used to help you complete this process.

You'll see the Online Resource Centre mentioned throughout the book.

The lecturer area of the Online Resource Centre provides additional materials to make the book easier to teach from. These materials include:

- figures from the book, available to download for use in lecture slides; and
- a test bank of questions.

Simply go to www.oxfordtextbooks.co.uk/orc/holmes3e/ and register as a user of the book to gain free access to these materials.

And finally...

Just in case OUP ask us to produce a fourth edition, we would like to hear about any errors (we hope there are none) and any suggestions you have for improvements. You can contact us by using the 'Send us your feedback' option in the Online Resource Centre.