

Preface	p. xi
Introduction	p. 1
Why do life scientists need to know about experimental design and statistics?	p. 1
What is this book designed to do?	p. 5
'Doing science' - hypotheses, experiments, and disproof	p. 7
Introduction	p. 7
Basic scientific method	p. 7
Making a decision about an hypothesis	p. 10
Why can't an hypothesis or theory ever be proven?	p. 11
'Negative' outcomes	p. 11
Null and alternate hypotheses	p. 12
Conclusion	p. 13
Collecting and displaying data	p. 14
Introduction	p. 14
Variables, experimental units, and types of data	p. 14
Displaying data	p. 16
Displaying ordinal or nominal scale data	p. 20
Bivariate data	p. 23
Multivariate data	p. 25
Summary and conclusion	p. 26
Introductory concepts of experimental design	p. 27
Introduction	p. 27
Sampling - mensurative experiments	p. 28
Manipulative experiments	p. 32
Sometimes you can only do an unreplicated experiment	p. 39
Realism	p. 40
A bit of common sense	p. 41
Designing a 'good' experiment	p. 41
Conclusion	p. 42
Probability helps you make a decision about your results	p. 44
Introduction	p. 44
Statistical tests and significance levels	p. 45
What has this got to do with making a decision or statistical testing?	p. 49
Making the wrong decision	p. 49
Other probability levels	p. 50
How are probability values reported?	p. 51
All statistical tests do the same basic thing	p. 52
A very simple example - the chi-square test for goodness of fit	p. 52
What if you get a statistic with a probability of exactly 0.05?	p. 55
Statistical significance and biological significance	p. 55
Summary and conclusion	p. 55

Working from samples - data, populations, and statistics	p. 57
Using a sample to infer the characteristics of a population	p. 57
Statistical tests	p. 57
The normal distribution	p. 57
Samples and populations	p. 63
Your sample mean may not be an accurate estimate of the population mean	p. 65
What do you do when you only have data from one sample?	p. 67
Why are the statistics that describe the normal distribution so important?	p. 71
Distributions that are not normal	p. 72
Other distributions	p. 73
Other statistics that describe a distribution	p. 74
Conclusion	p. 75
Normal distributions - tests for comparing the means of one and two samples	p. 77
Introduction	p. 77
The 95% confidence interval and 95% confidence limits	p. 77
Using the Z statistic to compare a sample mean and population mean when population statistics are known	p. 78
Comparing a sample mean with an expected value	p. 81
Comparing the means of two related samples	p. 88
Comparing the means of two independent samples	p. 90
Are your data appropriate for a t test?	p. 92
Distinguishing between data that should be analysed by a paired sample test or a test for two independent samples	p. 94
Conclusion	p. 95
Type 1 and Type 2 errors, power, and sample size	p. 96
Introduction	p. 96
Type 1 error	p. 96
Type 2 error	p. 97
The power of a test	p. 100
What sample size do you need to ensure the risk of Type 2 error is not too high?	p. 102
Type 1 error, Type 2 error, and the concept of biological risk	p. 104
Conclusion	p. 104
Single factor analysis of variance	p. 105
Introduction	p. 105
Single factor analysis of variance	p. 106
An arithmetic/pictorial example	p. 112
Unequal sample sizes (unbalanced designs)	p. 117
An ANOVA does not tell you which particular treatments appear to be from different populations	p. 117
Fixed or random effects	p. 118
Multiple comparisons after ANOVA	p. 119
Introduction	p. 119

Multiple comparison tests after a Model I ANOVA	p. 119
An a-posteriori Tukey comparison following a significant result for a single factor Model I ANOVA	p. 122
Other a-posteriori multiple comparison tests	p. 123
Planned comparisons	p. 124
Two factor analysis of variance	p. 127
Introduction	p. 127
What does a two factor ANOVA do?	p. 129
How does a two factor ANOVA analyse these data?	p. 131
How does a two factor ANOVA separate out the effects of each factor and interaction?	p. 136
An example of a two factor analysis of variance	p. 139
Some essential cautions and important complications	p. 140
Unbalanced designs	p. 149
More complex designs	p. 149
Important assumptions of analysis of variance: transformations and a test for equality of variances	p. 151
Introduction	p. 151
Homogeneity of variances	p. 151
Normally distributed data	p. 152
Independence	p. 155
Transformations	p. 156
Are transformations legitimate?	p. 158
Tests for heteroscedasticity	p. 159
Two factor analysis of variance without replication, and nested analysis of variance	p. 162
Introduction	p. 162
Two factor ANOVA without replication	p. 162
A-posteriori comparison of means after a two factor ANOVA without replication	p. 166
Randomised blocks	p. 167
Nested ANOVA as a special case of a one factor ANOVA	p. 168
A pictorial explanation of a nested ANOVA	p. 170
A final comment on ANOVA - this book is only an introduction	p. 175
Relationships between variables: linear correlation and linear regression	p. 176
Introduction	p. 176
Correlation contrasted with regression	p. 177
Linear correlation	p. 177
Calculation of the Pearson r statistic	p. 178
Is the value of r statistically significant?	p. 184
Assumptions of linear correlation	p. 184
Summary and conclusion	p. 184
Simple linear regression	p. 186
Introduction	p. 186

Linear regression	p. 186
Calculation of the slope of the regression line	p. 188
Calculation of the intercept with the Y axis	p. 192
Testing the significance of the slope and the intercept of the regression line	p. 193
An example - mites that live in the your hair follicles	p. 199
Predicting a value of Y from a value of X	p. 201
Predicting a value of X from a value of Y	p. 201
The danger of extrapolating beyond the range of data available	p. 202
Assumptions of linear regression analysis	p. 202
Further topics in regression	p. 204
Non-parametric statistics	p. 205
Introduction	p. 205
The danger of assuming normality when a population is grossly non-normal	p. 205
The value of making a preliminary inspection of the data	p. 207
Non-parametric tests for nominal scale data	p. 208
Introduction	p. 208
Comparing observed and expected frequencies - the chi-square test for goodness of fit	p. 209
Comparing proportions among two or more independent samples	p. 212
Bias when there is one degree of freedom	p. 215
Three-dimensional contingency tables	p. 219
Inappropriate use of tests for goodness of fit and heterogeneity	p. 220
Recommended tests for categorical data	p. 221
Comparing proportions among two or more related samples of nominal scale data	p. 222
Non-parametric tests for ratio, interval, or ordinal scale data	p. 224
Introduction	p. 224
A non-parametric comparison between one sample and an expected distribution	p. 225
Non-parametric comparisons between two independent samples	p. 227
Non-parametric comparisons among more than two independent samples	p. 232
Non-parametric comparisons of two related samples	p. 236
Non-parametric comparisons among three or more related samples	p. 238
Analysing ratio, interval, or ordinal data that show gross differences in variance among treatments and cannot be satisfactorily transformed	p. 241
Non-parametric correlation analysis	p. 243
Other non-parametric tests	p. 245
Choosing a test	p. 246
Introduction	p. 246
Doing science responsibly and ethically	p. 255
Introduction	p. 255
Dealing fairly with other people's work	p. 255
Doing the experiment	p. 257
Evaluating and reporting results	p. 258

Quality control in science p. 260

References p. 261

Index p. 263

Table of Contents provided by Blackwell's Book Services and R.R. Bowker. Used with permission.