
The biotechnology revolution is gaining strength in agriculture and, in spite of concerns expressed in Europe and North America, is almost certain to have a major impact on food sustainability in developing countries. There has been much spoken and written about specific issues in relation to this technology such as biosafety and intellectual property rights but very little on how to manage its uptake. This book sets out to fill this gap.

Managing Agricultural Technology is aimed at providing agricultural research managers and directors, especially in developing countries, with information to help them manage agricultural research programmes involving biotechnology more effectively. It documents the combined experiences of various people heavily involved in the uptake of this technology analysing the various problems that may be encountered. Although it is slanted to the experiences of the International Services for National Agricultural Research (ISNAR) which is associated with this publication, the overview is realistic and, on the whole, generally applicable. One small point with ISNAR’s involvement is that full credit is not given to the input of some other organizations such as the Rockefeller and McKnight Foundations into the uptake of this technology.

The book has five sections, ‘Addressing Management and Policy Issues’, ‘Setting and Implementing Priorities’, ‘Maximizing Benefits from Resources’, ‘Ensuring Environmental Responsibility and Managing IPR’, ‘Proprietary Science and Technology Transfer’. Within each of these sections are three to seven chapters dealing with specific issues. Each chapter has an abstract and conclusions which should appeal to the busy manager who does not have time to read the book in its entirety. The appendices cover Accessing Electronic Information with a list of useful Web sites and a glossary of biotechnological and other technical terms. The former is essential in a subject which is changing so rapidly that certain details of any book on the subject are out of date by the time of publication; the latter should make the book more accessible to the manager untrained in biotechnology.

This book is an important contribution to facilitating the uptake of biotechnology. It should be on the bookshelves of agricultural research managers and decision makers and they should read at least the abstracts and conclusions.

R. HULL


The introduction explains that this book was developed from a series of lecture notes prepared by the authors for an ADAS training course for agricultural research workers. The training course ‘concentrated on the practical application of statistics in agricultural research’ and the ‘text covers the basic concepts and theories underlying experimental design and the main statistical techniques that can be used to analyse and model data from designed experiments’. There are eight chapters and two appendices comprising: Introduction, pp. 1–4; Planning, pp. 5–17; Design, pp. 18–40; Trial structure, pp. 41–86; Data Entry and Exploration, pp. 87–113; Analytical Techniques, pp. 114–234; Other Statistical Techniques, pp. 235–244; Aspects of Computing, pp. 245–249; Appendix I, Glossary of Statistical Terms, pp. 250–253 and Appendix II, Analysis of Variance Formulae, pp. 254–274. Chapters 2–4 cover statistical design aspects whereas Chapters 5–8 cover analysis and interpretation aspects. I will discuss individual chapters separately and then give an overview.

Chapter 2 outlines some common sense considerations such as the formulation of ideas and the definition of objectives. On p. 9 it is stated that ‘every objective has one null and one alternative hypothesis’ and throughout the book it is assumed that every experiment has a null hypothesis to be tested. Certainly, the classical Fisherian view was that ‘every experiment may be said to exist only in order to give the facts a chance of disproving the null hypothesis’. However, in most experiments the null hypothesis is untenable and a more modern view is that experiments are designed to estimate treatment effects and that
significance tests are simply a measure of the precision of estimation of treatment effects relative to background variability. I think the role of hypothesis testing is over-emphasized and there is too little emphasis given to treatment estimation.

Chapter 3 outlines some ideas needed in the design of experiments. Choice of treatments, some aspects of data recording and the need for replication, blocking and randomization are discussed. Analysis of covariance for improving experimental precision is discussed briefly. Two examples of blocking are discussed, the first being a wheat agronomy experiment and the second a dairy cow feeding experiment. The wheat crop experiment had a $3 \times 4 \times 5$ complete factorial treatment structure and was arranged in three complete replicate blocks of 60 plots. The feeding trial animals had between one and five previous lactations and were grouped into five blocks according to their previous number of lactations. More could have been said about both these examples. For field trials, blocks of size 60 are very large and most statisticians would have wanted to see the block size reduced in some way. In the feeding trial, the number of previous lactations was a quantitative level factor that could well have interacted with the effects of diets. Neither of these issues is discussed in the book.

Chapter 4 discusses some aspects of trial design covering block and treatment structures. Factorial designs are discussed in some detail and an example of a two-way factorial plus control design is discussed. Split-plot designs for factorial experiments are also discussed. The use of block designs to control nuisance effects such as positional effects in field trials or differences in initial weight in animal feeding trials are discussed. Two-way elimination of nuisance effects by Latin squares is discussed and three examples of Latin squares are given. The third example, a $6 \times 6$ Latin square, is incorrect. The restricted availability of Latin square designs due to the need for the replication number to equal the treatment number is rightly emphasized. Finally, there is a brief mention of balanced incomplete block designs (BIBs) and cross-over designs. There is no mention of Trojan square designs for the generalization of Latin square designs or of lattice, generalized lattice or general incomplete block designs for the generalization of BIB designs. Fractionation of factorial designs is mentioned very briefly but not under that name. Although the overall discussion is useful, I think the designs covered are too limited to provide a good guide to modern practice in experimental design.

Chapter 5 discusses issues such as the distinction between discrete and continuous data, scales of measurement and the need for data checking and validation. Data exploration is then discussed using a range of summary statistics, graphics and tabulation methods.

Chapter 6 on analytical techniques is very long and comprises about half the book. Pages 114–209 cover analysis of variance and regression techniques while pp. 209–234 cover a range of non-parametric techniques. The analysis of variance section begins with examples of $t$-tests and $F$-tests concentrating very much on significance testing and using data from real experiments. The mean and standard error for the first example on p. 116 are incorrect. There is then a substantial section on data checking, the need to check model assumptions and the use of histograms and residual plots to check for skewness of distributions and non-homogeneity of variances. Variance stabilizing and normalizing transformations are discussed and then several practical examples with real data from a range of experiments are discussed. I am puzzled that the authors use the histograms of the raw data as well as the histograms and scatter plots of the residual values when choosing a data transformation. For example, on p. 134 they say of the histogram of a transformed data set 'The shape is not particularly bell-shaped but this alone is never used as evidence for transforming data, therefore it is still worth looking at the graphs of the residuals…'. In fact, only the distribution of the residuals is important in choosing a data transformation. The distribution of the raw data involves treatment mean effects and is not useful for assessing error variability. This is very confusing. A useful section follows on the analysis of means by polynomial contrasts and multiple range tests with the final part of the parametric analysis section devoted to simple ideas on regression analysis and regression diagnostics for model fit based on residual scatter plots.

The non-parametric section covers a wide range of techniques including runs tests, Chi-square goodness-of-fit tests, Kolmogorov–Smirnov tests, signs tests, Wilcoxon ranks tests, median tests, Kruskall–Wallis tests and the Fishers’s and $\chi^2$ tests for contingency table analysis. Each test is illustrated by a very brief practical example. Of these techniques, only contingency table analysis is of broad general importance in agricultural research and I would have preferred to see more emphasis on this technique and less on the others.

Chapter 7 gives a brief outline, without examples, of a range of techniques from multivariate analysis and time series analysis.

Chapter 8 briefly mentions and contrasts two data analysis computer packages Minitab and Genstat but without practical examples or illustrations of data analysis.

Appendix I contains a glossary of statistical terms used in the text. Appendix II contains a very detailed presentation of analysis of variance formulae for calculating the sums of squares, degrees of freedom, mean squares and variance ratios of the examples presented in the book.
Two important topics not explicitly mentioned in the book are covariance adjustment for plot position in field trials and analysis of repeated measurement data. Elimination of positional trend effects in field trials by covariance analysis can give large improvements in efficiency and field trial plot residuals should always be checked for positional trend effects. Repeated measures data from the same experimental plots or units are common in agricultural research and deserve special mention in any text on the interpretation of agricultural data.

Overall, my view is that the practical nature of the book will make it of some interest to agricultural research workers. The book contains some useful background information on the need for good design in agricultural research and gives a good range of examples in the analysis of practical experiments. However, there are numerous ambiguities and inaccuracies and I cannot give the book a general recommendation as a guide to the design and interpretation of experiments.

R. Edmondson


Together with the Tithe Awards and Lloyd George’s ‘Domesday’ of 1910, the 1941–1943 National Farm Survey provides a major benchmark in the agricultural history of modern Britain and an enormously impressive research database for those concerned with more general aspects of social and cultural change. The survey, majestic in conception and colossal in execution, was the brainchild of the Central Statistical Office which opened in 1941 and lost little time in launching this project of quite awesome magnitude. As the State became increasingly involved in the affairs of agriculture after 1931 it was widely held that a degree of surveillance beyond the range of the June Returns alone was essential if the authorities were to accumulate the requisite data for advanced planning purposes. Hence the National Farm Survey, embracing all holdings of more than five acres. Unlike the 1910 ‘Domesday’ which was primarily concerned with identifying ownership for fiscal purposes and thereby included all hereditaments both urban and rural, the National Farm Survey addressed the physical issues of the farm holdings and their management and in so doing provided an unparalleled cross-sectional view of British farming in wartime. University departments, the Ministry of Agriculture, the Land Commission and the County War Agricultural Executive Committees were all involved in some shape or form with the conducting of the survey which was eventually analysed (on the advice of R. A. Yates of Rothamsted) on the basis of a 15 per cent sample, and published in 1946 as *The National Farms Survey of England and Wales*. Not surprisingly the undertaking generated a prodigious volume of forms, maps, field books, working notes and other data most of which found its way to the Public Records Office where it remained confidential until 1992. Thereafter, with commendable despatch and industry, Brian Short and his colleagues managed to persuade the E.S.R.C. to provide funds to enable much of the material to be committed to a database and the present book tells the tale of this somewhat Herculean task.

But the work goes far beyond mere technical considerations. The Survey is set within its social and political context, the *dramatis personae* are highlighted, and a valuable and informative critique of the methodology and organization of the project carefully and thoughtfully provided. The latter is largely achieved by an examination of subsamples of 1450 holdings from the national sample, 1200 from the Midlands and 600 from Sussex. Besides indicating areas of inconsistency and error, this exercise incontrovertibly demonstrates the tremendous value of this newly available source of material as a tool in the study of recent agricultural, social and cultural history. Alongside detailed maps of individual farms we have information on occupation, labour profile, cropping, the condition of homes, buildings and cottages, the state of fencing, drainage and mechanization, the degree of pest and disease control, the extent of dereliction, the quality of management and much more besides. Rather controversially – and this was doubtless the reason why the records remained confidential for so long – each farm was graded according to the competence or otherwise of its occupier, and where the field surveyor considered him incompetent, unequivocal reasons were given. During the War, of course, the County War Agricultural Executive Committees, whose appointees tended to carry out the fieldwork for the Survey, were instruments of enormous (and occasionally misplaced) power. Inevitably there was a degree of jobbery and nepotism involved on a local basis and it is not difficult to envisage – as with the management of the “plough-up” campaign – local surveyors of a vindictive nature viewing the Survey form as a way of settling old scores with a less than popular farmer. Accordingly some of the qualitative assessments returned in the Survey require highly critical evaluation, and future local studies based on this data will undoubtedly highlight some intriguing, if potentially embarrassing, relationships. Taken overall, however, those responsible for the National Farm Survey, working under difficult wartime conditions, produced
a body of material which redounds to their credit. The information offered government a snapshot of the “National Farm”, elaborated a framework for the post-war policy of State intervention, and provided the National Agricultural Advisory Service with a starting point from which to advance the quest of agricultural development after 1947.

In demonstrating the value of the National Farm Survey as a research tool, Brian Short and his collaborators have provided a signal service, and their book will be an inevitable launch pad for future historians of wartime and early post-war agriculture. I would like to know what the farmers thought of this Survey. We have plenty of anecdotal evidence that they were highly suspicious, both of the control-obsessed zealots on the County War Agricultural Executive Committees, and of the fact that the higher the degree of surveillance of farming, the more power to proponents of land nationalization like C. S. Orwin and Sir Daniel Hall. A series of local studies using the Survey in conjunction with the techniques of oral history would not only shed some light on this question, but tell us a good deal about rural social relations at a time of national crisis.

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