which the coordinates stand for the numbers, or proportions, of each type. The way in which these numbers change continuously in time, under the influences of differential viability, the chromosome breakage and recombination, and mutation, is described by the curve traced out by the point moving under these influences.

Differential geometry is therefore the natural setting for the mathematical study of this class of problems. It is remarkable that we have had to wait so long for the development of a coherent theory of the differential geometry of population genetics. A start was made by S. Shashahani (1979, Memoirs of the American Mathematical Society, No. 211), and the present monograph continues it. It contains four chapters, of which I and III are addressed by the author to 'the biologist'. I doubt whether they will be understood by many readers without postgraduate mathematics. The stylized used of 'biologists' to describe anyone else is a hindrance to communication that should be discarded.

These two chapters do however constitute a distinct stratum of the book, in which the author reviews the relevant parts of differential geometry, from a modern point of view. They show how selection, recombination and mutation are related to differential geometric concepts in general, and discuss the specializations that are required in the genetic context. One of the crucial ideas is the Shashahani metric, which is in fact a manifestation of the χ^2 measure of genetic distance, but which has the differential geometric property that a vector field (representing a set of forces tending to change the population) is the gradient of some function f with respect to this metric if the relative rate of change of x_i is proportional to $\partial f/\partial x_i$, where x_i is the frequency of Type i. There is a very interesting discussion of the rôle of entropy in population genetics, of the meaning and implications of linkage (dis)equilibrium, and of the ideas surrounding the belief that in 'real' populations, there is some function that can meaningfully be called 'fitness', that must increase with time. Stability is also considered.

Chapters II and IV, which the author calls the 'heart of the work', are disappointing in the sense that the detailed geometrical analysis contained in them, while it elucidates some of the mathematical problems raised elsewhere in the work, does not present these results in the form of biologically interpretable conclusions.

Akin's work is a substantial achievement in the extent to which it has brought together differential geometry and population genetics. The author's mastery of his material in both fields has led him to a relaxed and discursive style (in Chapters I and III) which makes his work a pleasure to read. At the same time it conveys the tantalizing feeling that in introducing us to the range of ideas contained in this monograph, Akin has brought us to the brink of very important advances in the future. In assisting others to join in their elaboration, *The Geometry of Population Genetics* could be one of the seminal works of its decade.

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an der HEIDEN, UWE. **Analysis of Neural Networks.** Lecture Notes in Biomathematics, Vol. 35. Springer-Verlag, Berlin, 1980, 157 pp. £13.00.

In this monograph the author sets up a fairly general system of nonlinear integral equations to model the relationship of spike activity and action potential in a neuron. The model includes the inhibitory–excitatory effects of neurons on each other in systems with possibly very large numbers of neurons. The treatment is sufficiently general to encompass several special cases that have previously been studied.

Despite references to a number of concrete examples, this book consists mainly of classical functional analysis. It is primarily concerned with obtaining conditions on the functions in the model which ensure the existence of stationary solutions, whether they are unique and whether they are stable. The treatment has no statistical or stochastic elements, so that the book has little of interest to statisticians as such.

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MOHSENIN, N. N. **Thermal Properties of Foods and Agricultural Materials.** Gordon and Breach, New York, 1980, 407 pp. $92.00.

This is a comprehensive review of experiments and techniques to establish relationships describing the heating and cooling of a wide range of materials, and their effects. The six chapters cover basic concepts and theory, determination of specific heat and other thermal properties, and application to practical problems, with many numerical examples. Regression, linear and nonlinear, is widely used, as are graphical methods, mainly for predicting the effects of conditions such as temperature and moisture. The use of nondimensional groups to reduce the number of predictor variates is a recurring feature. The Appendix, containing tables, could be a useful source of data for examples on regression and curve-fitting.

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CLIFF, A. D. and ORD, J. K. **Spatial Processes, Models and Applications.** Methuen, Andover, Hampshire, England, 1981, 266 pp. £12.50.

Interest in the analysis of spatial processes has grown rapidly, with studies including such diverse topics as the spread of rabies across Europe, the sprawl of urban development and the clumping of heather. One of the main tools available for analysis of spatial variation is spatial autocorrelation, and this text presents a cohesive and comprehensive account of both its theory and its application. A great deal of progress has taken place in the eight years since the authors first published *Spatial Autocorrelation*, and this book is in essence an extended revision.

The original hypothesis-testing approach, centred mainly around joint-count type statistics, has been heavily revised and now accounts for the first third of the book. The new part begins with the analysis of point patterns and includes, for example, good coverage of comparisons between the various distance techniques. However, in spite of the change of title the major theme is still spatial autocorrelation and its geographical applications, and whilst most developments in spatial processes are mentioned some are included only to the extent that they comply with the autocorrelation framework. For a general text there is, therefore, a considerable imbalance of treatment between the various approaches. The book continues with a presentation of spatial correlograms, which determine the scale at which processes are operating, and contains interesting sections on simultaneous and conditional schemes together with a discussion of the effect of autocorrelation upon tests of hypothesis. The final chapters examine both the analysis of regression residuals and the treatment of mixed regressive and autoregressive components.

In a *Biometrics* review of the earlier version (1974, **30,** 729) the criticism was made that the authors were clearly interested in the geographical applications of spatial techniques, yet appeared unaware of the large amount of parallel research in the biological field. To a certain extent this defect has been corrected, though a basic imbalance remains. The particular importance of the biometric approach is that the special relationship between, say, a plant and its environment means that spatial statistics may not only provide a description of pattern but may also be used interactively to provide biological inferences about mechanisms of growth, competition and spread. However, with the exception of a brief look at redwood seedling data, all the examples are nonbiological, though it must be stressed that they are still of considerable interest.

The authors often declare their strong geographic motivation and it is therefore really unfair to criticize their text for lack of biometric appeal. The book is well written and clearly presented, and the ideas developed in it are simply demonstrated with various examples. At a general level it fills an obvious gap in the literature and is to be strongly recommended.

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CORNELL, J. A. **Experiments with Mixtures: Designs, Models, and the Analysis of Mixture Data.** John Wiley, New York, 1981, 305 pp. £19.40.

This book is aimed at 'anyone who is engaged in planning or performing experiments with mixtures', and particularly at scientists in the chemical and food industries. I fear, however, that such potential readers will be deterred by the very laboured exposition and by the quick descent into heavy mathematics. The presentation is dominated by suffices, summation signs and matrices, and there are occasional occurrences of such phrases as 'a $(q-1)$-dimensional linear manifold in q-space' and 'a simple homorphic [*sic*] transformation of the original simplex space'.

Unfortunate wording in the 'Definition' on p. 4 gets the book off to a confusing start:

> In the general mixture problem, the response that is measured is a function only of the proportions of the ingredients present in the mixture and is not a function of the amount of the mixture.

This seems to imply that we cannot study mixtures of mustard and cress, as the yield from 20 seeds of mustard and 10 of cress is unlikely to equal that from 60 and 30 seeds respectively. The author's next paragraph goes some way towards correcting the definition, but then the proportions are said to be 'by volume, by weight, or by mole fraction', even though there are other possibilities, as in a yarn experiment with the fibre's maximum diameter kept constant, or a mustard-and-cress experiment with the total number of seeds per unit area kept constant.

Section 2.9, on residuals, is more unfortunate. For experiments with some or all of the design points replicated, the residuals are wrongly said to be 'meaningful' only if the number of distinct design points is greater than the number of terms in the model. Then follows the assertion that 'we shall strive to work with uncorrelated residuals', which overlooks the inevitable correlation between least squares residuals.

Also wrong is the assertion (p. 17) that lattice squares and rectangular lattices are balanced incomplete block designs. The statement (p. 106) that, in a culinary experiment, the twelve beef patties 'in each replication were prepared in a completely random order' suggests that the replications were randomized blocks, yet the analysis given (p. 280) is for a completely randomized design. The assumption (p. 163) that certain multiple observations 'are replicates and not duplicates' leaves me puzzled, and is another example of unsatisfactory use of design terminology.

'Model reduction' (§5.3 and §5.4) involves comparing the estimated error variances for, say, a quadratic model and the corresponding linear model. An example is discussed on p. 166 in which the difference between these two variances 'is less than half of the unit of measurement . . . , and therefore is probably not significantly large'. Similarly pp. 170–171 carry the statement: 'this estimate of variance was only three times the size of the actual unit of measurement which did not seem too large to us'. Such comparisons of a quantity in squared units with a quantity in linear units are howlers indeed.

Arithmetic precision needs more attention in some of the numerical examples: most residual mean squares are calculated to only two significant figures, and one such mean square, with only a single significant figure, is used as the denominator of an F-ratio calculated to five significant figures!

In his concluding remarks, the author comments on 'the brevity of time set aside in the preparation of this work'. Perhaps this remark helps to explain the book's defects, which prevent me from recommending it.

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