Book review

Bodmer, W.F.; Kingman, J.F.C. (eds.): Mathematical Genetics. A Discussion organized and edited by W. Bodmer and J. Kingman. Proc. of the Royal Society of London. B. Biological Sciences. Vol. 219, No. 1216. London: Royal Society 1983. 219–353 pp., several figs. and tabs. Soft bound £ 14.25.

This book comprises the papers presented at a Royal Society Discussion Meeting in April 1983. Additionally, the eleventh Fisher Memorial Lecture has been included in honour of the fundamental contributions made by R.A. Fisher to the subject of mathematical genetics.

First, some information concerning the content of the book: after some general "Introductory remarks" by J.F.C. Kingman on the use and role of mathematics in genetics, seven papers on very different topics are presented.

1. W.J. Ewens: Inference problems in population genetics: DNA sequences, restriction endonucleases and ascertainment sampling.

The last decade of population genetics theory can be characterized by an increased interest in inductive arguments, based on observed genetic data, rather than in deductive arguments based on theory and models. The author's consideration of various inference problems includes a discussion of general aspects like the necessity of a mathematical theory for the inference process etc. These problems are illustrated by reference to restriction endonuclease techniques and ascertainment sampling.

2. E.A. Thompson: Gene extinction and allelic origins in complex genealogies.

Data analysis in mathematical genetics raises problems of parametrizing genealogical structures using the probabilities of genetically distinct states of gene identity by descent. The author discusses probabilities of joint descent of founder genes and likely ancestries of alleles as alternative characterizations of relationship. Joint extinction probabilities of founder genes can also be derived as ancestral likelihoods.

3. A. Robertson and W.G. Hill: Population and quantitative genetics of many linked loci in finite populations.

At first the authors review theoretical studies on the effects of linkage on variability of quantitative traits and response to directional selection in finite populations. Compared to the negative linkage disequilibrium produced by truncation selection in infinite populations simulation studies demonstrate more pronounced effects of linkage on response in finite populations.

4. B. Charlesworth: Models of the evolution of some genetic systems.

Models of two aspects of genome evolution are reviewed: Conditions for the establishment of chromosome rearrangements (suppression of recombination between polymorphic genes that interact in their effects on fitness) and the spread of genomic elements (by differential contributions to gametes or by their ability to replicate and transpose themselves to new sites within the genome).

5. R.M. May and R.M. Anderson: Epidemiology and genetics in the coevolution of parasites and hosts.

Non-genetic studies focused on the population biology and epidemiology of the host-parasite association as well as genetic investigations on the role of the coevolution of hosts and parasites for the genetic diversity in natural populations and as a reason for sexual reproduction (neglecting density – and frequency-dependent effects associated with the transmission and maintenance of parasitic infections) are well known in this separate manner. This paper aims to combine these two aspects: epidemiology and genetics. One main conclusion is that 'successful' parasites need not necessarily evolve to be harmless. The evolutionary fate of any particular parasite-host association depends on the relation between parasite virulence and transmissibility and on the costs of host resistance.

6. J. Maynard Smith: Models of evolution.

From two asexual models ('Muller's ratchet' and a model due to Eigen and Schuster) it can be concluded that the accuracy of replication must reach a limiting value. If fitnesses depend on interactions with others two approaches are discussed: 'trait group' methods and game theory. If the interacting individuals are relatives the exact 'neighbour-modulated fitness' approach and the 'inclusive fitness' method are described.

7. S. Karlin and C. Matessi: Kin selection and altruism. In this 11th R.A. Fisher Memorial Lecture the authors start from a discussion of Hamilton's rules and proceed to an intrinsic 'fitness function' approach to modelling the theory of kin selection. The components of the model involve: a) the delineation of the basic group structure specifying individual relationships; b) the specification of local fitness functions that depend on group composition; c) the determination of average fitness functions for the different phenotypes with respect to the population at large. A pair of benefit and cost functions are derived, which are functions of the group composition and the numbers of altruist and selfish phenotypes. The quantitative validity of the Hamilton criterion for the evolution of altruism are assessed and reinterpreted by these investigations and results.

Most of the papers are followed by (only) one question from the discussion and the author's reply.

All contributions of this volume are excellently written in a very informative and comprehensive style keeping the mathematics involved on a relatively moderate level. This book can be recommended without any restriction to all who are interested in "Mathematical Genetics". Furthermore, some of the articles (Robertson/Hill and May/Anderson) are of special relevance for applications in animal and plant breeding.

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