



Evolutionary Dynamics: The mathematics of genes and traits (IOP Expanding Physics)

Hugo van den Berg

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This beautifully illustrated and stimulating book develops an understanding of the gene-to-trait problem in the context of evolutionary dynamics, from the modern perspective of integrative biology. This gene-to-trait problem lies at the heart of a great many questions in biology, evolutionary or otherwise. The author presents both elementary and advanced material in a way that brings out how the gene-to-trait problem is related to both bioinformatics and mathematical models of biological systems.

Key ideas and techniques that underlie some of the most widely-used bioinformatics methods are discussed in this integrative context. A range of examples of biomathematical models is developed in an evolutionary framework. The book covers the standard theories of evolutionary genetics and adaptive dynamics.

Bioinformatics techniques are discussed from the perspective of sequence analysis (alignment, hidden-Markov models, tree inference, and sequence-to-function mapping) and quantitative trait analysis. The two strands of evolutionary dynamics and bioinformatics are then brought together in a chapter on the evolutionary dynamics of quantitative traits, which leads to a number of insights that become the basis for a general definition of fitness, discussed in the context of the question whether it is valid to argue from optimality criteria in an evolutionary context.

Written for researchers and postgraduate students with a background in physics or applied mathematics and a desire to apply their skills to problems in the life sciences, the book includes a number of introductory chapters on genetics and cell biology, phylogeny and development, mathematical probability, and inferential statistics. In addition, appendices summarise background material on speciation and systematics, controversies surrounding evolutionary thinking, dynamical systems, optimality arguments, as well as statistical and thermal physics.

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