
Foreword

Statistics? Not for us! Surprisingly, this is still what can sometimes be heard when discussing statistics with scientists from applied disciplines. How is it that such people disregard the science of doubt? No doubt that practitioners possess a deep understanding of phenomenological behavior of the system under study. They also have an acute feeling of its variability and its complexity. They have elaborated a mental image of the phenomenon, with operational shortcuts and permanent reformulations. Dare we say: the seed for a *model* is already set in their minds. At the same time, they never blindly trust model outputs and agree that statistics is necessary to depict things that happened in the past and to make projections about what may occur in the future. However, they also often complain that the basic statistical procedures are too simple and not flexible enough to address real problems they have to struggle with, and one has to acknowledge that instruction manuals for more advanced statistical tools are rarely funny readings! The present book might not be exactly a funny reading, but we hope that it could contribute to make the first steps of statistical modeling and inference more accessible, and tear-free, to a wide community of practitioners.

In Ecology, interestingly, complex issues have often been the hotbed of development of innovative statistical methodology. Statistical Ecology, a branch of ecological sciences, has proved incredibly productive in the last thirty years. However, temptation remains to apply *ready-to-use* statistical recipes, and frustration can be heavy when the data and the problem at hand do not fit exactly into the mold of the classical statistical toolboxes. But, to sacrifice the model realism for the sake of statistical tractability, or to defer to the sole mathematician the inference of the more complex model formulation, is that the unavoidable dilemma? In both cases, the analyst is deprived from the exciting intellectual adventures of model making!

This book was written because we believe that Hierarchical Bayesian Modeling is like a golden key to be given to scientists in Ecology. This avenue of thought should highly contribute to free their creativity in designing statistical models of their own.

In this book, we first recall that the principles of Bayesian statistics are not difficult to learn and can be intuitively understood. Bayesian statistical inference is merely learning from data by updating prior probabilistic judgments into posterior beliefs. Bayesian statistical modeling offers an intuitive avenue to put structures on data, to test ideas, to investigate several competing hypotheses and to assess degrees of confidence of predictions.

We also illustrate how conditional reasoning is a way to dismantle a complex reality into more understandable pieces. The construction of complex models is achieved by assembling basic elements linked via conditional probabilities that form the core of the hierarchical model structure. As conditional reasoning is intimately linked with Bayesian thinking, considering hierarchical models within the Bayesian setting offers a unified coherent framework for modeling, estimation and prediction.

Key ideas of this book have emerged through discussions with colleagues and PhD students. Étienne Prévost spent a whole research career working on salmon and Bayes, and many chapters are inspired by our collaborations. We are grateful that he allowed us to present in this book a lot of examples and data from his work. For the Scorff databases, field data collection has been carried out under his supervision by the personnel from the Moulin des Princes experimental station. Many thanks to the team of Fisheries and Oceans Canada in Moncton, where it all began. In 2005, we set up there a two-week Bayesian school with our friend Étienne Prévost. Gerald Chaput, Hugues Benoit and their colleagues suggested we write this book. We heard again the same suggestions during the 2006 and 2007 doctoral sessions that we organized for the Marine Exploited Ecosystems Research Unit (UMR EME) in Sète, France, to promote Bayesian thinking for modeling ecological data. We are particularly grateful to Daniel Gaertner, Nicolas Bez, Jean-Marc Fromentin and Frédéric Ménard who encouraged us on the way. We would like to thank Jean-Luc Baglinière (INRA, UMR ESE, Rennes) without whom the long series of data on A. salmon populations in the Oir and Scorff Rivers would not exist, and all the staff of the Unité Expérimentale d'Écologie et d'Écotoxicologie (INRA, U3E, Rennes), in particular Nicolas Jeannot and Frédéric Marchand for their invaluable work in the field collecting the salmon trapping data in the Scorff and Oir Rivers.

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Jérôme Guitton patiently helped us to master enough *html* programming language to implement our website *hbm-for-ecology.org*. This website gives many of the datasets, R and WinBUGS or OpenBUGS codes that we used to derive inference and figures in the book.

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