From statistics to knowledge

M.G. Myriam Hunink

Dicing with Death: Chance, Risk and Health
by Stephen Senn
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The role of statistics is to translate information into knowledge, which is, according to Stephen Senn, the challenge that faces statisticians. In *Dicing with Death: Chance, Risk and Health*, Senn explains statistical concepts as they are

relevant to healthcare, by answering questions such as: 'how do we interpret data from medical studies?', and 'what is the best decision based on that data?' He discusses how to assess the value of data and emphasizes that collecting reliable statistics is demanding. He highlights the fact that statistical modelling is complex and that good quantitative prediction is extremely difficult. Finally, Senn describes the investigation of causality and how to assess our ability to affect health. All in all, the reader gets a good overview of the important limitations of statistics, and the book is also a tribute to statisticians.

The statistical concepts that are explained include some that are commonly misunderstood, such as significance testing and the *P*-value. Significance testing starts with a null hypothesis and then addresses the question 'if the null hypothesis is correct, how unusual are the data?' If the data are unusual—for example, if a very low *P*-value is found—the null hypothesis is rejected, so the alternative hypothesis is likely to be true. One can never 'prove' anything with statistics, one can only determine how likely something is. Senn describes Simpson's paradox, which concerns the observation that an association

between two factors can be reversed when a third factor is taken into account. Regression towards the mean is discussed as a powerful and widespread cause of spontaneous improvement, for example when individuals have been selected for a study because they have extreme values of an indicator. This demonstrates the importance of a proper control group. The distinction between a frequentist approach and a Bayesian approach is elucidated: the frequentist calculates the probability of the observations given the hypothesis, whereas the Bayesian revises the probability that the hypothesis is true based on the observed data.

Clinical trial design is discussed and the author explains the advantages and disadvantages of the standard: the randomized, controlled trial. The limited ability to generalize the results of such a trial is one of the main problems. The challenge is to choose the inclusion and exclusion criteria wisely so that the correct balance between a homogeneous group that can be well described, versus a broad representation of the target group, is found. This enables clinicians to apply the results to their patients. From an ethical perspective, patients may only be randomized between treatments that are truly equivalent; this can commonly lead to dilemmas for physicians due to experience and prejudices.

Senn draws on some of the classic examples from statistics and epidemiology, so some will be familiar to readers. A few well-known large studies are mentioned, such as the Physician's Health Study. The Cochrane Collaboration and the Evidence-Based Medicine group at McMaster University (Ontario, Canada) are discussed. Senn also describes silicone-gel breast implants and their possible role in the development of connective tissue disorders, and the controversy over the safety of the measles-mumps-rubella vaccination gets some attention.

The explanation of statistical concepts is interlaced with interesting tidbits of history and philosophy of science. For example, I learned that Bernoulli was not one person but a whole family of Swiss mathematicians. I also learned that Sir Ronald Fisher never intended randomization to exclude other precautions as regards study design,

such as adjusting for imbalance between the groups. And the distinction between William Cochran, a statistician, and Archie Cochrane, an epidemiologist, was clarified.

Many pre-eminent figures in the history and philosophy of medical statistics enter the discussion, including Fisher, Karl Pearson, Harold Jeffreys, Bruno de Finetti, David Hume, Karl Popper, Sir Richard Doll, Sir Austin Bradford Hill, Francis Galton, Sir David Cox, Siméon Denis Poisson, Sir Iain Chalmers and even David Sackett from the field of evidence-based medicine. Furthermore, the text is interspersed with excellent quotes relevant to statistics, such as: "It is not that figures lie, but that liars sometimes figure" (Sir Maurice Kendall). Senn's quotes, anecdotes, references to world literature and historical digressions indicate that he is an intellectual who has read extensively.

Although Senn has clearly done a good job in describing various concepts, I found that at times the explanations were superficial. The book is intended for the general public, but without some mathematical and medical background it would be a tough read. The steps of the explanations are sometimes too big, making it difficult to follow the line of reasoning. Occasionally, the author digresses too much, making it hard to focus on the main message. All in all, *Dicing with Death* is not an easy read; it requires effort, concentration and some background knowledge. I would not recommend it to my closest friends nor to my clinical colleagues. I would, however, recommend it to my methodologically oriented colleagues, and students in biostatistics, epidemiology, public health, technology assessment, medical decision making and medicine. This book would have made useful supplementary reading for my statistics class back in medical school. If you like an intellectual challenge and are interested in medical statistics, then this is a wonderful book for you.

M.G. Myriam Hunink is Professor in the Departments of Epidemiology & Biostatistics, and Radiology, at the Erasmus University Medical Centre, Rotterdam, The Netherlands.
E-mail: m.hunink@erasmusmc.nl

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