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Book Review

Terje Aven, *Quantitative Risk Assessment – The Scientific Platform*, Cambridge University Press, 2011, 211pp. (£35 hardback, £25 e-book [kindle]). ISBN: 978-0-521-76057-7

Introduction

This book aims to build a unifying scientific framework for evaluating the quality of risk assessments; aimed at professionals, graduate students and researchers, the idea is to provide a framework for analysing risk assessments using the scientific requirements of reliability and validity:

- *"reliability"=the consistency of the 'measuring instrument' (experts, methods, procedures)*
- *"validity"=the assessment's success at 'measuring' what it set out to measure.*

The book argues that risk assessment is a science in its own right and cannot be judged by reference to traditional sciences, such as natural sciences, social sciences, mathematics and probability theory.

Quantitative Risk Assessment (QRA)

QRA synthesises the present state of knowledge, including uncertainties, about the phenomena, processes, activities and systems being analysed.

It identifies possible hazards/threats, analyses their causes and consequences, and describes risk, for characterising the likely impacts of the activity under study, for evaluating whether risk is tolerable or acceptable and for choosing the most effective and efficient risk policy.

Risk is a fundamental concept for most scientific disciplines; the book argues that no consensus exists on how to define and interpret risk and discusses a number of definitions:

- *A concept based on events, consequences and uncertainties*
- *A modelled, quantitative concept*

The author proposes the following definition of risk assessment *"the development of concepts, principles, methods and models to identify, analyse and evaluate (assess) risk"* (Aven, 2004).

Scientific Examples/Case Studies

The book's main examples are typical catastrophic events such as fire, explosion etc. for an LNG (Liquefied Natural Gas) plant, with some additional references to deep-sea diving risks, terrorism events and climate change. The book is awash with acronyms such as ALARP (as low as reasonably possible), ICAF (implied cost of averting a fatality), VPF (the value of preventing one statistical

fatality), VSL (the value of statistical life), WTP (willingness to pay), MFDT (mean fault detection time), FTA (fault tree analysis) and ETA (event tree analysis).

Relevance to Actuaries

The topic will be familiar to actuaries, especially general insurance actuaries; the book dives straight in with probabilities and equations, which are used heavily throughout; in the Appendix a basic understanding of statistics is assumed *(starting with the 3 interpretations of a probability [classical, frequency-based, knowledge-based [Bayesian])*, rapidly developing into the Beta Binomial distribution, hypothesis testing and Bayesian statistics, all familiar to actuaries.

For expert witnesses giving testimony on the basis of probabilities, for example the classical one-in-a-million probability example (Meadow's "Law", now discredited (Hill, 2004) – multiple cot deaths within a single family, expressed in common parlance *"One [cot death] is a tragedy, two is suspicious and three is murder unless there is proof to the contrary"*), the book would be an essential pre-read before cross-examination.

The Book's Strengths and Weaknesses

The book clearly acknowledges that risk assessments:

- *give the risk industry the aura of being scientific, since most risk assessments show that activities are safe*
- *can be complex, and highly dependent on the premises and assumptions, that there is plenty of room for "adjustments" of the assumptions and methods to meet any risk acceptance criteria*
- *allow governments to hide behind 'rationality' and 'objectivity' as they permit and allow hazardous activities that may harm people and the environment*
- *are often based on selective information, arbitrary assumptions and enormous uncertainties*
- *will seldom be in a format that provides all the answers important to the decision maker*

In response, the author states that there is no alternative to risk assessment; to support the decision-making process risk needs to be assessed. The challenge is how decision-making on risk can be informed by the best technical and scientific knowledge available. The author quotes Apostolakis (2004) *"I wish to make one thing very clear; QRA results are never the sole basis for decision making by responsible groups. In other words safety-related decision making is risk–informed, not risk–based."*

The book's main weakness is that it will be of more use to theoreticians than actuaries or risk managers; it lacks the complete picture of real decisions made in real situations, showing real documentation of how a risk assessment has been used in a real-life process, backed up by the other information which was used to inform the decision-making process, and how this would be communicated clearly to perhaps less numerate professionals e.g. Chief Executives.

In addition, the book focuses on the classical LNG catastrophe problem; more examples would have been informative. Further, actuaries are usually more concerned with the pricing of risks in a commercial context; the book could have been therefore usefully extended to situations where risk

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management is deemed too expensive, thus explaining how an insurer *("the most effective and efficient risk policy")* would price the "unwanted" risk in a way consistent with the risk owner's own assessment.

Further, the book has a very high usage of acronyms and equations almost straight from the start, which would put many readers off, and although there is a summary at the end, it does not really have any succinct 'take away' points, with the exception of perhaps the key message *"Risk extends beyond probabilities; probability is just a tool used to express the uncertainties, it is not a "perfect" tool"*, a simple message which is perhaps lost in the main narrative.

Summary

The book is certainly a rigorous treatise on theoretical definitions of risk, risk quantification and risk assessment.

Actuaries will be familiar with all of the arguments and examples stated in the book but will gain little practical take-away information on applying the learning points in the real-life discussions with perhaps less numerate risk managers, insurance underwriters and Boards of Directors.

Nevertheless this book is useful to have in your reference library as a background on theoretical risk assessment definitions in case your work is ever questioned in a Court or you are called as an expert witness in a probability-related case.

In summary, whilst the book does state the old actuarial maxim that *"all models are wrong but some are useful"* it is a useful reference tool on alternative ways of discussing risk assessment problems.

John Birkenhead

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