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978-0-521-36542-0 - Uncertainty: A Guide to Dealing with Uncertainty in Quantitative Risk and Policy Analysis

M. Granger Morgan and Max Henrion

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Uncertainty

A Guide to Dealing with Uncertainty in
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Solum certum nihil esse certi

The only certainty is uncertainty

Pliny the Elder, *Historia Naturalis*, Bk ii, 7

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M. GRANGER MORGAN AND MAX HENRION

with

a chapter by Mitchell Small



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Cambridge, New York, Melbourne, Madrid, Cape Town, Singapore, São Paulo

Cambridge University Press

The Edinburgh Building, Cambridge CB2 8RU, UK

Published in the United States of America by Cambridge University Press, New York

www.cambridge.org

Information on this title: www.cambridge.org/9780521365420

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First published 1990

Reprinted 1991

First paperback edition 1992

Reprinted 1994, 1995, 1998, 1999, 2003, 2004

A catalogue record for this publication is available from the British Library

ISBN 978-0-521-36542-0 hardback

ISBN 978-0-521-42744-9 paperback

Transferred to digital printing 2007

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Preface

To people trained in the physical sciences dealing with uncertainty is almost second nature. Serious physical scientists would not report an experimental result without an associated estimate of uncertainty, nor would they design a new experiment without giving careful attention to uncertainties. Thus, when we first left the physical sciences and started doing policy analysis, we simply did what came naturally. We worried about uncertainty. It didn't take long to discover that only a handful of other analysts (most of them trained in decision analysis or engineering) shared our concern. It took only a little longer to understand that, with its enormous inherent uncertainties, the field of policy analysis needs to be concerned with the characterization and analysis of uncertainty to an extent that far exceeds the need in the physical sciences. We set out to do such analysis, and along the way to build computer-based tools which would make the job easier. In the process, we discovered that what really matters is the training and philosophy of the analysts who use these tools. Through the doctoral program in the Department of Engineering and Public Policy at Carnegie Mellon University we have invested heavily in such education.

Today, while the adequate treatment of uncertainty in policy analysis is still the exception, not the rule, the exceptions are becoming more frequent. Throughout regulatory agencies, in executive branch staffs, national laboratories, universities, industry, and the halls of Congress, thoughtful people are coming to the same conclusion . . . "it really isn't safe to be ignoring all this uncertainty; it may be important to the decisions we must make."

This book is designed for four audiences: practicing analysts who have become persuaded that dealing with uncertainty is important and want to learn how to do it; students who are just getting started in quantitative policy analysis and want to develop good skills and habits; managers or decision makers who are unlikely to ever do much analysis on their own but want to understand the available techniques well enough to know what to request, and how to critique the results; and the growing community of skilled analysts who work on these issues regularly, but do not yet have a general reference text that summarizes the basic ideas and techniques of the field in one convenient place. To all of you we hope that the ideas and pages that follow will give as much enjoyment and challenge as they have given us in their development, synthesis, and writing.

The preparation of this book was assisted by many people, among the most important of whom have been several successive groups of doctoral students in the Graduate Research Methods course of the Department of Engineering and Public Policy at Carnegie Mellon University. We are particularly grateful to Greg

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PREFACE

McRae for many useful discussions and ideas; to Sam Morris, who collaborated on much of the research that got us started in this field; to Theresa Mullin, who kindly allowed us to use short excerpts of text from her Ph.D. thesis in portions of Chapters 6 and 7; and to Patti Steranchak, who helped us handle the innumerable details of producing the manuscript. Among the other colleagues, students, and family members who deserve special thanks are: Deborah Amaral, Hal Bamford, Nat Barr, Robyn Dawes, Greg Fischer, Baruch Fischhoff, Bob Hahn, Harald Ibrekk, Jay Kadane, Lester Lave, Victoria Massimino, Tom McCurdey, Betty Morgan, Frederick Morgan, Indira Nair, Warner North, Harvey Richmond, Bill Rish, Paul Slovic, and Maxine Small.

Primary support for the preparation of this book was provided by the U. S. National Science Foundation under grant PRA 8413097/-01. Support for many of the specific results reported has come from a variety of sources including NSF grants IST-8112439, IST-8316890, IST-8514090/-01, PRA-7913070, and SES-8715564; various contracts from the Health and Environmental Risk Assessment Program of the U.S. Department of Energy; the Biomedical and Environmental Assessment Division of Brookhaven National Laboratories; and the Department of Engineering and Public Policy of Carnegie Mellon University. Support for the final preparation of the manuscript was provided by a grant from the Alcoa Foundation.