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Statistical Tools for Nonlinear Regression

A Practical Guide
with S-PLUS Examples

With 45 Illustrations



Springer

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Mathematics Subject Classification (1991): 02.70, 62F03, 62F25, 62J02, 62J20

Library of Congress Cataloging-in-Publication Data
Statistical tools for nonlinear regression : a practical guide / S.

Huet . . . [et al.].

p. cm. — (Springer series in statistics)

Includes bibliographical references and index.

ISBN 978-1-4757-2525-4

ISBN 978-1-4757-2523-0 (eBook)

DOI 10.1007/978-1-4757-2523-0

1. Regression analysis. 2. Nonlinear theories. 3. Parameter estimation. I. Huet, S. (Sylvie) II. Series.

QA278.2.S73 1996

519.5'36—dc20

96-13753

Printed on acid-free paper.

© 1996 Springer Science+Business Media New York

Originally published by Springer-Verlag New York, Inc. in 1996

Softcover reprint of the hardcover 1st edition 1996

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Production managed by Natalie Johnson; manufacturing supervised by Jeffrey Taub.
Camera-ready copy prepared using the authors' LaTeX files.

9 8 7 6 5 4 3 2 1

ISBN 978-1-4757-2525-4

SPIN 10533039

Preface

If you need to analyze a data set using a parametric nonlinear regression model, if you are not on familiar terms with statistics and software, and if you make do with **S-PLUS**, this book is for you. In each chapter we start by presenting practical examples. We then describe the problems posed by these examples in terms of statistical problems, and we demonstrate how to solve these problems. Finally, we apply the proposed methods to the example data sets. You will not find any mathematical proofs here. Rather, we try when possible to explain the solutions using intuitive arguments. This is really a *cook book*.

Most of the methods proposed in the book are derived from classical nonlinear regression theory, but we have also made attempts to provide you with more modern methods that have proved to perform well in practice. Although the theoretical grounds are not developed here, we give, when appropriate, some technical background using a sans serif type style. You can skip these passages if you are not interested in this information.

The first chapter introduces several examples, from experiments in agronomy and biochemistry, to which we will return throughout the book. Each example illustrates a different problem, and we show how to methodically handle these problems by using parametric nonlinear regression models. Because the term *parametric model* means that all of the information in the experiments is assumed to be contained in the parameters occurring in the model, we first demonstrate, in chapter 1, how to estimate the parameters. In chapter 2 we describe how to determine the accuracy of the estimators. Chapter 3 introduces some new examples and presents methods for handling nonlinear regression models when the variances are heteroge-

neous with few or no replications. In chapter 4 we demonstrate methods for checking if the assumptions on which the statistical analysis is based are accurate, and we provide methods for detecting and correcting any misspecification that might exist. In chapter 5 we describe how to calculate prediction and calibration confidence intervals.

Because good software is necessary for handling nonlinear regression data, we provide, at the end of each chapter, a step-by-step description of how to treat our examples using **nls2** [BH94], the software we have used throughout this book. **nls2** is a software implemented as an extension of the statistical system **S-PLUS**, available by <http://www-bia.inra.fr/> or by ftp [www-bia.inra.fr](ftp://www-bia.inra.fr/pub/log/nls2) in `pub/log/nls2`, and offers the capability of implementing all of the methods presented in this book.

Last but not least, we are grateful to Suzie Zweizig for a careful rereading of our English. Thanks to her, we hope that you find this book readable!

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