Manual of Pharmacologic Calculations

With Computer Programs

Second Edition

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With Computer Programs

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With 28 Figures

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Preface to the Second Edition

This book contains a collection of quantitative procedures in common use in pharmacology and related disciplines. It is intended for students and researchers in all fields who work with drugs. Many physicians, especially those concerned with clinical pharmacology, will also find much that is useful. The procedures included may be considered "core" since they are generally applicable to all classes of drugs. Some of the procedures deal with statistics and, hence, have even wider application.

In this new edition we have increased the number of procedures from 33 (in the first edition) to 48. Other procedures have been revised and expanded. Yet the basic philosophy of this new edition remains unchanged from the first. That is, the pharmacologic basis of each procedure is presented, along with the necessary formulas and one or more worked examples. An associated computer program is included for each procedure and its use is illustrated with the same worked example used in the text. The discussions of theory and the sample computations are brief and self-contained, so that all computations can be made with the aid of a pocket calculator and the statistical tables contained in Appendix A. Yet it is realized that the proliferation of lower-priced microcomputers is likely to mean that more and more readers will utilize a computer for most calculations. Accordingly, we have modified the format of the book to facilitate computer usage.

In contrast to the first edition, which was divided into Part I for text and calculation and Part II for computer screens and programs, this edition provides a different, more usable format in which the text of each procedure is immediately followed by the computer screens. These screens, generated by the master program (called PHARM/PCS), use the data from the text example and show the user how data are entered and results received. It is recommended that the text of a procedure and its worked example be read and understood, and,

subsequently entered into the associated computer routine. In some cases results of the computer analysis will differ in the second or third decimal place from those given in the text example. The slight difference is due to roundoff that inevitably accompanies hand calculation. Instructions for using the computer program are given in an introductory chapter. The appendix contains a complete listing of the program that may be of value to experienced programmers who wish to modify parts for their own specialized use.

The computer program is vastly enhanced over that contained in the first edition. Provision is now made for saving and editing data files. Also the program diskette (available separately) contains many of the statistical tables, thereby obviating the need for many of the tables in Appendix A. The current program now generates neatly formatted reports which may be saved onto disk to merge with text files when preparing manuscripts that contain both text and tables.

The following procedures are new to this edition:

11. Relative Potency II: Statistical Analysis
28. Pharmacokinetics III: Volume of Distribution
29. Pharmacokinetics IV: Plasma Concentration-Time Data
30. Pharmacokinetics V: Renal Clearance
31. Pharmacokinetics VI: Renal Excretion Data Following Intravenous Administration
32. Pharmacokinetics VII: Multiple Dosing from Absorptive Site
34. Analysis of Variance II: Two-Way, Single Observation
35. Analysis of Variance III: Two-Way, with Replication
36. Newman-Keuls Test
37. Duncan Multiple Range Test
38. Least Significant Difference Test
41. Ratio of Means
43. Proportions: Confidence Limits
47. Litchfield and Wilcoxon II
48. Differential Equations

The authors are grateful to our many colleagues who have communicated with us and offered many valuable suggestions. Special thanks are due Joseph Aceto, and Professor Alan Cowan of Temple University, Professor Frank Porreca of the University of Arizona (Tucson) and Dr. William Schmidt of E.I. Du Pont Company.

Information regarding procurement of the computer disk is given after Appendix B or may be obtained by writing to the authors.

Ronald J. Tallarida
Rodney B. Murray

Preface to the First Edition

This book provides a collection of quantitative procedures in common use in pharmacology and related disciplines. The procedures we selected may be considered "core" since it is likely that all scientists who work with drugs will use these procedures at some time or another. By excluding very specialized topics, we managed to keep the size of the book small, thus making it handy for quick reference—a handbook in the true sense.

Since many scientists and students now have access to electronic computers, and since the advent of lower cost microcomputers is likely to increase computer availability even further, we also included a computer program for each procedure.* The user need not know computer programming since all necessary information needed to run the programs is included here.

The manual is divided into two parts. In the first, the pharmacologic basis for the calculation is briefly stated for each of the procedures (numbered 1 through 33). Then the appropriate equations (formulas) are given and an example of each calculation is provided. For each procedure, the discussion of theory and illustration of the calculation are brief and self-contained. With the tables in the Appendix and a pocket calculator, all of the calculations can be done without reference to any other source. It is recommended that the procedure and sample calculation be read and understood before going to the automated "magic" of the computer program in Part II. This will ensure an understanding of the theory, particularly the possible limitations of the theory to the data in question.

The computer programs (written in standard BASIC) in Part II are numbered corresponding to their Part I equivalent, prefixed with the code S (programs are

* All computer programs are available on cassette tape or disk. Information on their purchase may be obtained by writing the authors or by referring to the last page of this volume.

also called subroutines). For example, S5 is the program for performing the computations of Procedure 5, *Analysis of the regression line*. All that is necessary is that the desired programs be accurately typed into the computer. Preferably, they should be stored on a disk or tape for loading when they are to be used; the user then need only type RUN and the number of the desired procedure. The computer will ask for the data, which the user types in. The computer then gives the results of the analysis.

For each of the 33 programs in Part II, we give an example of the user's interaction with the computer. The use of the same data in the computer example and in the text example allows the user to relate the knowledge gained in Part I to the use of the computer. The user should actually enter the sample data for a particular program before trying other data, and the results should agree with that given in this book. Erroneous results would indicate that the program was typed in wrong. Details of the computer operation are given in the introduction to Part II.

The authors are grateful to our many friends and colleagues who helped in so many ways in the preparation of this work. We owe special thanks to Alan Cowan, Paul McGonigle, Frank Porreca, Robert Raffa, Mary Jane Robinson, Theresa Tallarida, and Mark Watson for their help with the proofreading and for several valuable suggestions.

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