Introductory Statistics

Fourth Edition

Prem S. Mann

FOURTH EDITION

INTRODUCTORY STATISTICS

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EASTERN CONNECTICUT STATE UNIVERSITY

JOHN WILEY & SONS, INC.
NEW YORK • CHICHESTER • WEINHEIM • BRISBANE • SINGAPORE • TORONTO

To my parents

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The cover was printed by Lehigh Press.
Cover photo by: © Lois Ellen Frank/CORBIS.
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To order books please call 1(800)-225-5945.

Library of Congress Cataloging in Publication Data:
Mann, Prem S.
Introductory statistics / Prem S. Mann—4th ed.
p. cm.
Includes index.
ISBN 0-471-37353-2 (cloth: alk. paper)
1. Statistics. I. Title.

QA276.12.M29 2001
519.5—dc21

Printed in the United States of America

10 9 8 7 6 5 4 3 2 1

PREFACE

Introductory Statistics is written for a first course in applied statistics. The book is intended for students who do not have a strong background in mathematics. The only prerequisite for this text is a knowledge of elementary algebra.

Today, college students from almost all fields of study are required to take at least one course in statistics. Consequently, the study of statistical methods has taken on a prominent role in the education of students majoring in all fields of study. The goal of this text is to make the subject of statistics both interesting and accessible to such a wide and varied audience. Three major characteristics of this text support this goal: the realistic content of its examples and exercises that draw on a comprehensive range of applications from all facets of life, the clarity and brevity of its presentation, and the soundness of its pedagogical approach. These characteristics are exhibited through the interplay of a variety of significant text features.

The feedback received from the users of the third edition of *Introductory Statistics* has been very encouraging. This feedback serves as evidence of the success of the text in making statistics interesting and accessible—a goal of the author from the very first edition. The author has pursued the same goal through the refinements and updates in this fourth edition so that *Introductory Statistics* will continue to provide a successful experience in statistics to growing numbers of students and professors.

NEW TO THE FOURTH EDITION . . .

The following are some of the many significant changes made in the fourth edition of the text without changing its main features.

- A large number of exercises of greater difficulty have been added to all chapters except Chapter 1. These exercises appear under the heading **Advanced Exercises** as part of the supplementary exercises.
- All problems containing real data have been updated or replaced by new problems with real data.
- A large number of examples and case studies have been changed and updated to capture the interest of students and maintain relevancy.
- New chapter-ending **Mini-Projects** are data oriented, and can be given as group assignments during class or as homework.
- The MINITAB sections have been updated to the 13th Version. These sections now appear in **Appendix B** and include both the MINITAB PULL-DOWN MENUS and the MINITAB COMMAND LANGUAGE instructions.
- New **Excel Adventures** have been added to the text and they appear in **Appendix C**. These adventures show how to use Excel to solve statistics problems.

- For those who wish to have the option of using a graphing calculator in solving statistical exercises, a few exercises from each chapter that are suitable for this purpose have been identified with an icon. Graphing Calculator solutions for the odd-numbered problems are given as part of the answer section at the back of the book. However, these exercises can also be solved without using the graphing calculator.
- All data sets that appeared in Appendix B in the third edition have been updated. These data sets now appear in the Instructor's Solution Manual, Student's Solution Manual, on the Instructor's Resource CD that accompanies the text, and on the Web site for the text, www.wiley.com/college/mann.
- A new section on the test for correlation coefficient has been added to Chapter 13.
- A new Chapter 14 on Nonparametric Methods has been added to the text.
- Presentation of concepts has been refined at many places to enhance clarity.

HALLMARK FEATURES OF THIS TEXT

Style and Pedagogy

Clear and Concise Exposition The explanation of statistical methods and concepts is clear and concise. Moreover, the style is user-friendly and easy to understand. In chapter introductions and in transitions from section to section, new ideas are related to those discussed earlier.

Abundant Examples

Examples The text contains a wealth of examples, a total of 211 in 14 chapters and Appendix A. The examples are usually given in a format showing a problem and its solution. They are well-sequenced and thorough, displaying all facets of concepts. Furthermore, the examples capture students' interest because they cover a wide variety of relevant topics. They are based on situations practicing statisticians encounter every day. Finally, a large number of examples are based on real data that are taken from sources such as books, government and private data sources and reports, magazines, newspapers, and professional journals.

Realistic Settings

Solutions A clear, concise solution follows each problem presented in an example. When the solution to an example involves many steps, it is presented in a step-by-step format. For instance, examples related to tests of hypotheses contain five steps that are consistently used to solve such examples in all chapters. Thus, procedures are presented in the concrete settings of applications rather than as isolated abstractions. Frequently, solutions contain highlighted remarks that recall and reinforce ideas critical to the solution of the problem. Such remarks add to the clarity of presentation.

Guideposts

Margin Notes for Examples A margin note appears beside each example that briefly describes what is being done in that example. Students can use these margin notes to assist them as they read through sections and to quickly locate appropriate model problems as they work through exercises.

Frequent Use of Diagrams Concepts can often be made more understandable by describing them visually, with the help of diagrams. This text uses diagrams frequently to help students understand concepts and solve problems. For example, tree diagrams are used extensively in Chapters 4 and 5 to assist in explaining probability concepts and in computing probabilities. Similarly, solutions to all examples about tests of hypotheses contain diagrams showing rejection regions, nonrejection regions, and critical values.

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Highlighting Definitions of important terms, formulas, and key concepts are enclosed in color boxes so that students can easily locate them. A similar use of color is found in the *Using MINITAB* sections where a color tint highlights MINITAB solutions. Important terms appear in the text either in boldface or italic type.

☞ **Cautions** Certain items need special attention. These may deal with potential trouble spots that commonly cause errors. Or they may deal with ideas that students often overlook. Special emphasis is placed on such items through the headings: *Remember, An Observation,* or *Warning.* An icon is used to identify such items.

Realistic Applications

Case Studies Case studies, which appear in many chapters, provide additional illustrations of the applications of statistics in research and statistical analysis. Most of these case studies are based on articles/snapshots published in journals, magazines, or newspapers. All case studies are based on real data.

Abundant Exercises

Exercises and Supplementary Exercises The text contains an abundance of exercises, a total of 1486 in 14 chapters and Appendix A (excluding Computer Assignments). Moreover, a large number of these exercises contain several parts. Exercise sets appearing at the end of each section (or sometimes at the end of two or three sections) include problems on the topics of that section. These exercises are divided into two parts: **Concepts and Procedures** that emphasize key ideas and techniques, and **Applications** that use these ideas and techniques in concrete settings. Supplementary exercises appear at the end of each chapter and contain exercises on all sections and topics discussed in that chapter. A large number of these exercises are based on real data taken from varied data sources such as books, government and private data sources and reports, magazines, newspapers, and professional journals. Exercises given in the text do not merely provide practice for students, but the real data contained in exercises provide interesting information and insight into economic, political, social, psychological, and other aspects of life. The exercise sets also contain many problems that demand critical thinking skills. The answers to selected odd-numbered exercises appear in the *Answers Section* at the back of the book. **Optional exercises** are indicated by an asterisk (*).

Advanced Exercises All chapters (except Chapter 1) now have a set of exercises that are of greater difficulty. Such exercises appear under the heading *Advanced Exercises* as part of the *Supplementary Exercises.*

Summary and Review

Glossary Each chapter has a glossary that lists the key terms introduced in that chapter, along with a brief explanation of each term. Almost all the terms that appear in boldface type in the text are in the glossary.

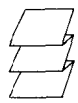
Key Formulas Each chapter contains a list of key formulas used in that chapter. This list appears before the *Supplementary Exercises* for each chapter.

Self-Review Tests Each chapter contains a *Self-Review Test*, which appears immediately after the *Supplementary Exercises.* These problems can help students to test their grasp of the concepts and skills presented in respective chapters and to monitor their understanding of statistical methods. The problems marked by an asterisk (*) in the *Self-Review Tests* are **optional.** The answers to almost all problems of the *Self-Review Tests* appear in the *Answer Section.*

Formula Card A formula card that contains key formulas from all chapters is included at the beginning of the book.

Technology

Computer Usage Another feature of this text is the detailed instructions on the use of **MINITAB**.[1] *Using MINITAB* sections for 13 of the 14 chapters and Appendix A appear in **Appendix B**. Each of these *Using MINITAB* sections contains a detailed description of the MINITAB commands that are used to perform the statistical analysis presented in the text. These sections now include both the MINITAB PULL-DOWN MENUS step-by-step instructions and the MINITAB COMMAND LANGUAGE instructions to perform statistical data analysis. In addition, each of these sections contains several illustrations that demonstrate how MINITAB can be used to solve statistical problems. These MINITAB instructions and illustrations are so complete that students do not need to purchase any other MINITAB supplement. Computer assignments are also given at the end of each chapter so that students can further practice MINITAB. A total of 80 computer assignments are contained in these sections.



Excel Adventures Written by Jeff Mock of Diablo Valley College, **Appendix C** contains worked examples, called *Excel Adventures*, which show the various uses of Excel in performing statistical analysis. Three different methods are used depending on the content of the chapter—the student may be required to enter a formula or to utilize Excel's Data Analysis Command or Statistical Analysis ToolPak. Basic manipulative skills such as entering data, copying, cut-paste, opening files, and saving files as well as more extensive statistical applications can be obtained in the supplemental ***Excel Manual*** accompanying this text.

Graphing Calculator More and more instructors are now using graphing calculators, such as the TI-83 or the TI-83+, to teach statistics. A few exercises from each chapter in the text have been identified and marked with a **calculator icon** as suitable exercises for graphing calculators. The complete solutions to these exercises along with the TI-83 screen reproductions are provided in the *Instructor's Solutions Manual*. Graphing Calculator answers are provided for such odd-numbered exercises as part of the answer section at the back of the book. Note that these exercises can also be solved without using a graphing calculator.

Calculator Usage The text contains many footnotes that explain how a calculator can be used to evaluate complex mathematical expressions.

Data Sets Four data sets appear in the Instructor's Solutions Manual, Student Solutions Manual, on CD, and on the Web site for the text. These data sets, collected from different sources, contain information on many variables. They can be used to perform statistical analysis with statistical computer software such as MINITAB or Excel. **These data sets are available from the publisher on a diskette/CD in MINITAB format, Excel format, and in ASCII format**. These data sets can also be downloaded from the Web site for the text.

WEB SITE

http://www.wiley.com/college/mann

The Mann Statistics Web site provides resources for instructors and students. The graphing calculator programs for running complex statistical tests on the TI-83 can be downloaded

[1]MINITAB is a registered trademark of Minitab, Inc., 3081 Enterprise Drive, State College, PA 16801. Phone: 814-238-3280; fax: 814-238-4383; telex: 881612. The author would like to take this opportunity to thank Minitab, Inc., for their help.

from this site. Other resources include four large data sets that accompany the text and links to interesting statistical sites on the Web. Instructors can find information on changes in the new edition and contact Wiley for examination copies and supplements.

OPTIONAL SECTIONS

Because each instructor has different preferences, the text does not indicate optional sections. This decision has been left to the instructor. Instructors may cover the sections or chapters that they think are important. However, a few alternative one-semester syllabi are available on the Web site for this text.

Complete Learning System

SUPPLEMENTS

The following supplements are available to accompany this text.

Instructor's Solutions Manual This manual contains complete solutions to all exercises and the *Self-Review Test* problems.

Instructor's Resource CD Contains the data sets, full solutions manual, as well as:

- **Instructor's Resource Guide** Sample syllabi, discussion questions, sample exams and suggested homework assignments, and transparency masters are included in this resource. Written for both the experienced and inexperienced instructor, the manual offers a clear overview of the course while outlining major topics and key points of each chapter.
- **Test Bank** The printed copy of the test bank contains a large number of multiple choice questions, essay questions, and quantitative problems for each chapter.
- **Computerized Test Bank** All questions that are in the printed *Test Bank* are available on a diskette. This diskette can be obtained from the publisher.

Students' Solutions Manual This manual contains complete solutions to all of the odd-numbered exercises, a few even-numbered exercises, and all the *Self-Review Test* problems.

Student Study Guide This guide contains review material about studying and learning patterns for a first course in statistics. Special attention is given to the critical material of each chapter. Reviews of mathematical notation, formulas, and table reading are also included.

Wiley E Grade for Statistics Practice quizzes and tests for students and instructors appear on the Web site.

Graphing Calculator Manual This manual is a basic guide for beginners on the TI-83 and TI-83+. The authors guide students through the important facets of using a graphing calculator in statistics by presenting clear examples, pictures of actual calculator screens, and programs specific to each calculator.

Excel Manual This manual is an extension of the Excel Adventures given in Appendix C. In contains worked examples using current real data and Excel for the data analysis. The manual gives step-by-step instructions, screen captures to guide the students, as well as numerous applications of how to use Excel in statistics. The version of Excel used is Microsoft Excel 2000. Earlier versions of Excel are similar, and exact keystrokes may differ slightly.

ACKNOWLEDGMENTS

I thank the following reviewers of this, and/or previous editions of this book, whose comments and suggestions were invaluable in improving the text.

K. S. Asal
Broward Community College
Louise Audette
Manchester Community College
Nicole Betsinger
Arapahoe Community College
Joan Bookbinder
Johnson & Wales University
Dean Burbank
Gulf Coast Community College
Jayanta Chandra
University of Notre Dame
James Curl
Modesto Community College
Fred H. Dorner
Trinity University, San Antonio
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Roanoke College, Salem, Virginia
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Santa Fe Community College
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Florida Community College, Jacksonville
A. Eugene Hileman
Northeastern State University, Tahlequah, Oklahoma
John G. Horner
Cabrillo College
Virginia Horner
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Ina Parks S. Howell
Florida International University
Gary S. Itzkowitz
Rowan State College
Jean Johnson
Governors State University
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American River College, Sacramento
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Central Connecticut State University
Linda Kohl
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Pace University, Pleasantville, New York
Marlene Kovaly
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Richard McGowan
University of Scranton
Daniel S. Miller
Central Connecticut State University
Satya N. Mishra
University of South Alabama
Jeffrey Mock
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Villanova University
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New Mexico State University, Las Cruces
Phillis Schumacher
Bryant College, Smithfield
Kathryn Schwartz
Scottsdale Community College
Ronald Schwartz
Wilkes University, Wilkes-Barre
David Stark
University of Akron
Larry Stephens
University of Nebraska, Omaha
Bruce Trumbo
California State University, Hayward
Jean Weber
University of Arizona, Tucson
Terry Wilson
San Jacinto College, Pasadena
K. Paul Yoon
Fairleigh Dickinson University, Madison

I express my special thanks to Professor Gerald Geissert of Eastern Connecticut State University and Professor Daniel S. Miller of Central Connecticut State University. Professor Geissert checked solutions to all examples for mathematical accuracy, prepared answers to selected odd-numbered exercises for the answer section, and read proofs. Professor Miller and Professor Geissert both helped in writing the problems with greater difficulty that appear in the *Advanced Exercises*. In addition, I thank Eastern Connecticut State University for all the support I received. I thank many of my students who were of immense help during this revision. I also offer my thanks to my colleagues, friends, and family whose support was a source of encouragement during the period when I spent long hours working on this revision.

It is of utmost importance that a textbook is accompanied by complete and accurate supplements. I take pride in mentioning that the supplements prepared for this text possess these qualities and much more. I appreciatively thank the following authors of these supplements: Professor Jim Curl for writing the Study Guide, Professor John Horner and Professor Virginia Horner for preparing the Graphing Calculator Manual for TI-83 and TI-83+, Professor Jeff Mock for writing the Excel Manual, Professor Gerald Geissert for preparing the Solutions Manuals, and Professor Edwin C. Hackleman for writing the Test Bank.

It is my pleasure to thank all the professionals at John Wiley with whom I enjoyed working. Their names appear earlier in this text.

Any suggestions from readers for future revisions would be greatly appreciated. Such suggestions can be sent to the author through Internet address: MANN@ECSU.CTSTATEU.EDU.

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June 2000

GLOSSARY OF SYMBOLS

A	(1) y-intercept in the population regression model; (2) event A
a	y-intercept in the regression model estimated for sample data
$\overline{A}$	Complement of event A
α	(Greek letter *alpha*) Probability of Type I error or significance level
$(1 - \alpha)$	Confidence level
B	Slope of the population regression line
b	Slope of the regression model estimated for sample data
β	(Greek letter *beta*) Probability of Type II error
C	Number of columns in a contingency table
χ^2	(χ is Greek letter *chi*) Chi-square distribution
d	Difference between two paired values
$\overline{d}$	Mean of the paired differences for a sample
df	Number of degrees of freedom
E	(1) Maximum error of estimate; (2) expected frequencies
E_i	Simple event i for an experiment
e	(1) Random error, $y - \hat{y}$, for a regression model; (2) $e = 2.71828$ in the Poisson probability distribution
$E(x)$	Expected value of a random variable x
ϵ	(Greek letter *epsilon*) Random error term in the population regression model
f	Frequency of a category or class
F	The F distribution
H	Test statistic for the Kruskal–Wallis test
H_0	Null hypothesis
H_1	Alternative hypothesis
IQR	Interquartile range
k	(1) Number of different samples or treatments in a one-way ANOVA; (2) number of categories in a multinomial experiment
λ	(Greek letter *lambda*) Mean of the Poisson probability distribution
m	Midpoint of a class
μ	(Greek letter *mu*) Population mean
μ_b	Mean of the sampling distribution of b
μ_d	Mean of the paired differences for the population
$\mu_{\overline{d}}$	Mean of the sampling distribution of $\overline{d}$
$\mu_{\overline{x}}$	Mean of the sampling distribution of $\overline{x}$
$\mu_{\hat{p}}$	Mean of the sampling distribution of $\hat{p}$
μ_R	Mean of the sampling distribution of R for the runs test
μ_T	Mean of the sampling distribution of T in the Wilcoxon signed-rank test and the Wilcoxon rank sum test for large samples
$\mu_{y \cdot x}$	Mean of y for a specific value of x using population regression model
n	Sample size
$n!$	n factorial
$\binom{n}{x}$	Number of combinations of n elements selected x at a time
N	Population size
O	Observed frequency for a category or cell
p	(1) Population proportion; (2) probability of success for a binomial experiment
$\hat{p}$	Sample proportion
$\overline{p}$	Pooled sample proportion for two samples
P_k	kth percentile, where k is an integer from 1 to 99
$P(A)$	Probability that event A will occur
$P(A \text{ and } B)$	Joint probability of events A and B
$P(A \text{ or } B)$	Probability of the union of events A and B
$P(A \mid B)$	Probability that event A will occur given event B has occurred
q	$1 - p$, probability of failure for a binomial experiment

$\hat{q}$	$1 - \hat{p}$ where $\hat{p}$ is the sample proportion
$\bar{q}$	$1 - \bar{p}$ where $\bar{p}$ is the pooled sample proportion for two samples
Q_1, Q_2, Q_3	First, second, and third quartiles, respectively
R	(1) Number of rows in a contingency table; (2) number of runs for the runs test for randomness
r	Linear correlation coefficient for sample data
r^2	Coefficient of determination
r_s	Spearman *rho* rank correlation coefficient for sample data
ρ	(Greek letter *rho*) Linear correlation coefficient for population data
ρ_s	Spearman *rho* rank correlation coefficient for population data
S	Sample space
s	Sample standard deviation
s^2	Sample variance
s_b	Estimator of σ_b
s_d	Standard deviation of the paired differences for a sample
$s_{\bar{d}}$	Estimator of $\sigma_{\bar{d}}$
s_e	Standard deviation of errors for the sample regression model
s_p	Pooled standard deviation
$s_{\hat{p}}$	Estimator of $\sigma_{\hat{p}}$
$s_{\hat{p}_1 - \hat{p}_2}$	Estimator of $\sigma_{\hat{p}_1 - \hat{p}_2}$
$s_{\bar{x}}$	Estimator of $\sigma_{\bar{x}}$
$s_{\bar{x}_1 - \bar{x}_2}$	Estimator of $\sigma_{\bar{x}_1 - \bar{x}_2}$
$s_{\hat{y}_\mu}$	Estimator of $\sigma_{\hat{y}_\mu}$
$s_{\hat{y}_p}$	Estimator of $\sigma_{\hat{y}_p}$
Σ	(Greek letter capital *sigma*) summation notation
σ	(Greek letter lowercase *sigma*) Population standard deviation
σ^2	Population variance
σ_b	Standard deviation of the sampling distribution of b
σ_d	Standard deviation of the paired differences for the population
$\sigma_{\bar{d}}$	Standard deviation of the sampling distribution of $\bar{d}$
σ_e	Standard deviation of errors for the population regression model
$\sigma_{\hat{p}}$	Standard deviation of the sampling distribution of $\hat{p}$
$\sigma_{\hat{p}_1 - \hat{p}_2}$	Standard deviation of the sampling distribution of $\hat{p}_1 - \hat{p}_2$
σ_R	Standard deviation of the sampling distribution of R for the runs test
σ_T	Standard deviation of the sampling distribution of T in the Wilcoxon signed-rank test and the Wilcoxon rank sum test for large samples
$\sigma_{\bar{x}}$	Standard deviation of the sampling distribution of $\bar{x}$
$\sigma_{\bar{x}_1 - \bar{x}_2}$	Standard deviation of the sampling distribution of $\bar{x}_1 - \bar{x}_2$
$\sigma_{\hat{y}_\mu}$	Standard deviation of $\hat{y}$ when estimating $\mu_{y\|x}$
$\sigma_{\hat{y}_p}$	Standard deviation of $\hat{y}$ when predicting y_p
T	Test statistic for the Wilcoxon signed-rank test and the Wilcoxon rank sum test for a small sample
t	The t distribution
T_i	Sum of the values included in sample i in one-way ANOVA
T_U	The upper critical value for the Wilcoxon rank sum test
T_L	The lower critical value for the Wilcoxon rank sum test
X	Test statistic for the sign test for a small sample
x	(1) Variable; (2) random variable; (3) independent variable in a regression model
$\bar{x}$	Sample mean
y	(1) Variable; (2) dependent variable in a regression model
$\hat{y}$	Estimated or predicted value of y using a regression model
z	Units of the standard normal distribution

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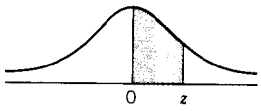
TABLE VII STANDARD NORMAL DISTRIBUTION TABLE†

The entries in this table give the areas under the standard normal curve from 0 to z.

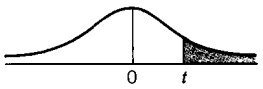


z	.00	.01	.02	.03	.04	.05	.06	.07	.08	.09
0.0	.0000	.0040	.0080	.0120	.0160	.0199	.0239	.0279	.0319	.0359
0.1	.0398	.0438	.0478	.0517	.0557	.0596	.0636	.0675	.0714	.0753
0.2	.0793	.0832	.0871	.0910	.0948	.0987	.1026	.1064	.1103	.1141
0.3	.1179	.1217	.1255	.1293	.1331	.1368	.1406	.1443	.1480	.1517
0.4	.1554	.1591	.1628	.1664	.1700	.1736	.1772	.1808	.1844	.1879
0.5	.1915	.1950	.1985	.2019	.2054	.2088	.2123	.2157	.2190	.2224
0.6	.2257	.2291	.2324	.2357	.2389	.2422	.2454	.2486	.2517	.2549
0.7	.2580	.2611	.2642	.2673	.2704	.2734	.2764	.2794	.2823	.2852
0.8	.2881	.2910	.2939	.2967	.2995	.3023	.3051	.3078	.3106	.3133
0.9	.3159	.3186	.3212	.3238	.3264	.3289	.3315	.3340	.3365	.3389
1.0	.3413	.3438	.3461	.3485	.3508	.3531	.3554	.3577	.3599	.3621
1.1	.3643	.3665	.3686	.3708	.3729	.3749	.3770	.3790	.3810	.3830
1.2	.3849	.3869	.3888	.3907	.3925	.3944	.3962	.3980	.3997	.4015
1.3	.4032	.4049	.4066	.4082	.4099	.4115	.4131	.4147	.4162	.4177
1.4	.4192	.4207	.4222	.4236	.4251	.4265	.4279	.4292	.4306	.4319
1.5	.4332	.4345	.4357	.4370	.4382	.4394	.4406	.4418	.4429	.4441
1.6	.4452	.4463	.4474	.4484	.4495	.4505	.4515	.4525	.4535	.4545
1.7	.4554	.4564	.4573	.4582	.4591	.4599	.4608	.4616	.4625	.4633
1.8	.4641	.4649	.4656	.4664	.4671	.4678	.4686	.4693	.4699	.4706
1.9	.4713	.4719	.4726	.4732	.4738	.4744	.4750	.4756	.4761	.4767
2.0	.4772	.4778	.4783	.4788	.4793	.4798	.4803	.4808	.4812	.4817
2.1	.4821	.4826	.4830	.4834	.4838	.4842	.4846	.4850	.4854	.4857
2.2	.4861	.4864	.4868	.4871	.4875	.4878	.4881	.4884	.4887	.4890
2.3	.4893	.4896	.4898	.4901	.4904	.4906	.4909	.4911	.4913	.4916
2.4	.4918	.4920	.4922	.4925	.4927	.4929	.4931	.4932	.4934	.4936
2.5	.4938	.4940	.4941	.4943	.4945	.4946	.4948	.4949	.4951	.4952
2.6	.4953	.4955	.4956	.4957	.4959	.4960	.4961	.4962	.4963	.4964
2.7	.4965	.4966	.4967	.4968	.4969	.4970	.4971	.4972	.4973	.4974
2.8	.4974	.4975	.4976	.4977	.4977	.4978	.4979	.4979	.4980	.4981
2.9	.4981	.4982	.4982	.4983	.4984	.4984	.4985	.4985	.4986	.4986
3.0	.4987	.4987	.4987	.4988	.4988	.4989	.4989	.4989	.4990	.4990

†This table is the same as Table VII of Appendix D.

TABLE VIII THE *t* DISTRIBUTION TABLE†

The entries in the table give the critical values of *t* for the specified number of degrees of freedom and areas in the right tail.



	Area in the Right Tail under the *t* Distribution Curve					
df	**.10**	**.05**	**.025**	**.01**	**.005**	**.001**
1	3.078	6.314	12.706	31.821	63.657	318.309
2	1.886	2.920	4.303	6.965	9.925	22.327
3	1.638	2.353	3.182	4.541	5.841	10.215
4	1.533	2.132	2.776	3.747	4.604	7.173
5	1.476	2.015	2.571	3.365	4.032	5.893
6	1.440	1.943	2.447	3.143	3.707	5.208
7	1.415	1.895	2.365	2.998	3.499	4.785
8	1.397	1.860	2.306	2.896	3.355	4.501
9	1.383	1.833	2.262	2.821	3.250	4.297
10	1.372	1.812	2.228	2.764	3.169	4.144
11	1.363	1.796	2.201	2.718	3.106	4.025
12	1.356	1.782	2.179	2.681	3.055	3.930
13	1.350	1.771	2.160	2.650	3.012	3.852
14	1.345	1.761	2.145	2.624	2.977	3.787
15	1.341	1.753	2.131	2.602	2.947	3.733
16	1.337	1.746	2.120	2.583	2.921	3.686
17	1.333	1.740	2.110	2.567	2.898	3.646
18	1.330	1.734	2.101	2.552	2.878	3.610
19	1.328	1.729	2.093	2.539	2.861	3.579
20	1.325	1.725	2.086	2.528	2.845	3.552
21	1.323	1.721	2.080	2.518	2.831	3.527
22	1.321	1.717	2.074	2.508	2.819	3.505
23	1.319	1.714	2.069	2.500	2.807	3.485
24	1.318	1.711	2.064	2.492	2.797	3.467
25	1.316	1.708	2.060	2.485	2.787	3.450
26	1.315	1.706	2.056	2.479	2.779	3.435
27	1.314	1.703	2.052	2.473	2.771	3.421
28	1.313	1.701	2.048	2.467	2.763	3.408
29	1.311	1.699	2.045	2.462	2.756	3.396
30	1.310	1.697	2.042	2.457	2.750	3.385
31	1.309	1.696	2.040	2.453	2.744	3.375
32	1.309	1.694	2.037	2.449	2.738	3.365
33	1.308	1.692	2.035	2.445	2.733	3.356
34	1.307	1.691	2.032	2.441	2.728	3.348
35	1.306	1.690	2.030	2.438	2.724	3.340
36	1.306	1.688	2.028	2.434	2.719	3.333
37	1.305	1.687	2.026	2.431	2.715	3.326
38	1.304	1.686	2.024	2.429	2.712	3.319
39	1.304	1.685	2.023	2.426	2.708	3.313
40	1.303	1.684	2.021	2.423	2.704	3.307
∞	1.282	1.645	1.960	2.326	2.576	3.090

†This table is an abbreviated version of Table VIII that appears in Appendix D. This table goes up to 40 degrees of freedom. For degrees of freedom from 41 to 70, use Table VIII of Appendix D.

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