Essential Mathematics and Statistics for Science

Graham Currel and Antony Dowman

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[Reviewed by David Mazel, on 07/3/2006]

What is a good way to learn and use statistics? Is it to pick up one book, read it, and apply the algorithms to one's problem? Should one have a single book for his/her work or many books? How much theory should one know? Lastly, how can one use the world-wide web with a text book?

Currell and Dowman have written a statistics textbook for students and researchers. Their book provides brief discussions, formulas, worked examples, and exercises (with short answers in the back) to illustrate topics and usage. In addition to the text itself, there is a well-organized and useful web site for the book (at http://www.wileyeurope.com/go/currellmaths). The web site provides supplementary help, in-depth solutions, and study resources. The text and web site complement one another and are excellent at giving the reader a workable grasp of the material.

The text begins with a gentle discussion of statistics, data, and numbers. It discusses units, conversion between units, and then measurements. The discussion and topics are a solid introduction for the beginning student. The book then guides the reader through manipulation of equations, relationships between variables (such as linear, quadratic and exponential) and discusses probability distributions such as normal, binomial, and Poisson. In the final chapters the book discusses statistical tests: F-test, t-test, Chi-squared, and non-parametric tests. All these topics are highly relevant to researchers, well presented, and easy to follow. The multitude of examples clarifies the text.

The authors state in the first sentence that the book is for "biological, environmental, chemical, forensic, and sport sciences." This is important because the book, which presents the material at that level, is not the most appropriate for mathematicians, physicists or engineers — anyone with a deeper mathematical background or interest. I was, in fact, often struck by the cook-book nature of the discussion.

I would have liked more discussion of the mathematics behind the ideas. For example, the method of linear fit is given without any theory. The text shows how to find the parameters with Excel but not what the Excel routines do. Many readers probably have Excel and for those who just want the answer, that may be all they need. (One note: While Excel is popular I urge authors to look at OpenOffice software, http://www.openoffice.org, in the future. It is free, easy to use, and not proprietary.)

What about using the world-wide web? The authors employ the web for detailed solutions and supplementary help for the reader. This is indeed a plus. Obviously, other web sites can provide details on any topic one desires. But I believe that having a text book with the web site is the better way to use the web. The reader sees a consistent presentation of each topic both on his paper page and his screen page. The textbook gives the researcher an easy to navigate source of topic, explanation, example, without having to load pages, or search multiple sites for details. Thus this book with its companion web site are all the better.

David Mazel is an engineer in the Washington, DC area. He received his bachelor's degree from Old Dominion University and his Master's and doctorate from Georgia Tech, all in electrical engineering. He is currently interested in billiards, cellular automata, and signal processing research.

Preface.


1.1 Data and information.

1.2 Experimental variation and uncertainty.
1.3 Mathematical models in science.

2. Scientific Data.

2.1 Scientific numbers.

2.2 Scientific quantities.

2.3 Angular measurements.


3.1 Basic equation handling.

3.2 Introduction to rearranging equations.

3.3 Rearranging complicated equations.

3.4 Solving equations.

3.5 Simultaneous equations.

4. Linear Relationships.

4.1 Straight-line graph.

4.2 Linear regression.

4.3 Linearization.

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5.1 Mathematics of e, ln and log.

5.2 Exponential growth and decay.

6. Rates of Change.

6.1 Rate of change.

6.2 Differentiation.

7. Statistics and Information.

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7.2 Frequency statistics.

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7.4 Bayesian odds.

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8. Distributions and Uncertainty.

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8.2 Uncertainties in measurement.

8.3 Experimental uncertainty.

8.4 Binomial distribution.

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9.1 Scientific systems.

9.2 The ‘scientific method’.

9.3 Hypothesis testing.


10.1 Sample variances: F-test.
10.2 Sample means: Student’s $t$-test.
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11.1 Test for frequencies.
11.2 Contingency tests.
11.3 Goodness of fit.

12.1 Wilcoxon tests.
12.2 Mann–Whitney test.
12.3 Kruskal–Wallis and Friedman tests.
12.4 Sign test.
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13.1 Data variance.
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Appendixes.

Review Questions.

Short Answers to In-text Questions.

Index.
Everything about maths & statistics for data science in easy language. Learn linear algebra, calculus, inferential, descriptive statistics with examples. Hope now you are clear with all the concepts related to mathematics and statistics for data science. It’s time to check how this concept will help you to get your first job in data science.

Provide your valuable feedback on the above topic through comments. Tags: data science hypothesis testing Linear Algebra in data science Math for Data Science mathematics for data science statistics for data science.

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Mathematics and statistics provide the network of links that tie together the details of our understanding, and create a sound basis for a fundamental appreciation of science as a whole. Without these quantifiable links, the ability of science to predict and move forward into new areas of understanding would be totally undermined. Data science is simply the evolved version of statistics and mathematics, combined with programming and business logic. I’ve met many data scientists who struggle to explain predictive models statistically. More than just deriving accuracy, understanding & interpreting every metric, calculation behind that accuracy is important. Remember, every “variable” has a story to tell. So, if not anything else, try to become a great story explorer! In this article, I’ve compiled a list of must-read books on statistics and mathematics.