# DEATH TO THE TEXTBOOK!

BEDWELL, Mike
Consultant, Kyiv, Ukraine
Michael_Bedwell@hotmail.com

*ABSTRACT*

*It will be argued that, at the introductory level at least, the Internet has rendered the statistics textbook redundant. This is because textbooks are inevitably out-of-date, often ossifying techniques rather than investigating fundamental concepts, especially those which continue to excite controversy to this day; these include Bayes' theorem and the competing merits of significance testing and of confidence levels. The author will cite evidence from the library of his own former university, and outline his plans for a Statistics Vademecum. This will not be a textbook, but rather series of questions which direct the reader to look up concepts on the internet and answer Socratic-style questions about them.. The vision is that the reader should arrive at an informed opinion on the cliché 'lies, damned lies….', and appreciate that is neither mathematics nor IT, but rather logic that presents the challenge in understanding statistics .*

## INTRODUCTION

For some years I had nursed the ambition to write my own textbook, but the impulse behind this paper was a survey of those who had been there before me. This consisted of an examination of the library shelves of Coventry University, my last full-time employer. I was disturbed to find, under the 'elementary' and 'introductory' headings alone, more than 100 titles; of these there were two or more copies of no fewer than 53, suggesting that they had been acquired for classroom use, and not just for research. From these 53, I took a stratified sample of 10.

## FINDINGS

I was particularly interested in answering the question 'how far would these texts help students to distinguish between the statistical terms *confidence* and *significance*, or, in an abbreviated form of Cumming's (2007) shorthand, to understand the "α–*p*" debate'? The answer was 'very little'; specifically, although several authors pointed out that $\alpha / p \approx 1$ when the null hypothesis $\mu_0$ coincides with one boundary of the confidence interval, none explicitly warned the reader against concluding that $\alpha \equiv p$, or, what is a only a little less sinful, that $\alpha / p$ is an adequate criterion for deciding between a null hypothesis and its alternative. One of statistics mnemonics listed by Hunt (2010) reinforces this latter miscomprehension.

In trying to get to grips with this issue I gained most enlightenment, not in any academic library, but rather from the general science shelves of the public library in Calne, an English town of fewer than twenty thousand souls. In particular, Matthews (2005a) gave the best explanation I have found of 'meta-analysis', a term frequently invoked by Cumming( *op cit*) and others in the α–*p* debate. Further, Matthews (2005b) devotes a whole chapter to the related topic of Bayesianism, including it as one of the 25 'big ideas' to emerge from the science of the past century. Other relevant popular works were those of Bill Bryson (2003) and the sometimes misinformed but stimulating best-sellers by the Taleb (2001, 2007). The treatment in all these books is compatible with my own view that the essentials of statistics can be taught with little mathematics (Bedwell, 2009).

Conscious both of the fundamental nature of this issue and of my own inability to resolve it, I concluded that any book I dare write should not join the ranks of those I am criticizing, but rather serve as a guide to internet-based sources through which readers might understand such issues, and even contribute to them.

## MY BOOK

Most of the premises on which my book would be based are listed in the Introduction in those pages I have so far drafted; these are shown in the Appendix. To expand on these premises, I need only emphasize here that:

- The target readership would be people competent to become informed customers, who are needed in far greater numbers than are applied statisticians. ( Wilde, C TS 33,1, 2011, pp 29-32)
- The body of the book would be multi-choice questions. While these have their pedagogic limitations; careful wording can lead to deep understanding, and even lead the student to challenge the received wisdom. Shy students who would never dare pose a question in a crowded lecture room will find it easier to air their views on a blog, or even by directly emailing some celebrated expert.
- The structure of the questions would be influenced by my having, in my old age, taken the *GMAT*.
- There would be a minimum of references to the literature in the conventional academic tradition, but rather italicized key terms for the reader to look up on Google.
- The only statisticians to be named would normally be dead ones!

CONCLUSIONS

Logic, together with grammar and rhetoric, constituted the *trivium* of medieval tertiary education. By considering inferential statistics as an extension of Logic, and exploiting the marvels of the computer-based search engine, students should be inspired to learn ancient wisdom through modern technology.

REFERENCES


Bedwell, M. ,2009. *Rescuing Statistics from Mathematicians*, Conference on Modeling in Mathematics Education, Dresden, Germany.

Bryson, Bill 2003. *A Short History of Nearly Everything*, Transworld, ISBN 0385 408188, p5

Cumming, G., 2007 Inference by Eye: *Pictures of Confidence Intervals and thinking about levels of Confidence.* Teaching Stastistics, 29, 3, 89-93.

Cumming, G (in press*). p values versus confidence intervals as warrants for conclusions that results will replicate.* In B. Thompson and R. Subotnik, methodologies for conducting research on giftedness. Washington DC. APA Books.

Hunt, N., 2010. *Using Mnemonics in Teaching Statistics*. Teaching Statistics, 32, 3,73-75.

Matthews, R, 2005a. *25 Big Ideas in Science*. Oneworld. ISBN 10:85168-391-7, p113

Matthews, R. 2005b. *Ibid*, pp 88-89.

Taleb, N.N. 2001 *Fooled by Randomness*. Random House. ISBN 0-8129-7521-9.

Taleb, N.N. 2007 *The Black Swan*. Random House. ISBN 978-1400063512.

Wilde, C. 2011. Quoted in Petocz, C and Sowey, E. *Statistical Diversions*, Teaching Statistics 33,1, pp 29-32


APPENDIX

**VADE MECUM**
**into Inferential Statistics**

*Vade mecum.* "Come with me…into all works" *Medieval Latin Dictionary*
"A coach – a friend at his elbow…" Thomas Hardy, *Jude the Obscure*
"Where is the wisdom we have lost in knowledge, …and the knowledge we have lost in information?" T.S.Eliot

FOREWORD

If this book has been recommended to you by a teacher, then what she or he says must take preference over what you read here. But if not, the only other resource you will need is Google. If this term is unfamiliar to you, ask your local library or almost any teenager! If they also recommend some conventional book, make sure this *on* statistics, not *of* them. The latter sort list data about the world we live in – liquidity ratios, divorce rates, football scores; the former

tells us how best to use such data in our decision-making: which shares to buy, how best to help the children of broken homes, who will win the next World Cup. This is the art of *inferential* statistics. While there is no substitute for the human "coach" Hardy's *Jude* so craved, but I hope this little book will serve as the next best thing.

My premises are:

1) You will find any number of books and websites out there giving you all the formal definitions, mathematical formulae and computer programs you'll ever want. But while applying statistics does make extensive use of mathematics and computers, you need little of either to understand its fundamental ideas. There's a parallel to physics here.
2) Indeed, the most difficult problems in statistics are ones of logic, not of mathematics or computing.
3) All maintenance technicians have a toolbox. They may never use some of the tools that it originally came with; while over the years they add others that experience dictates. They also have instruction manuals. Nobody in their right mind would test technicians' competence by asking them to define a screwdriver, or tell them to keep their manuals closed when solving a problem. So encourage anyone assessing your competence in statistics to set open-book examinations and problem-solving projects.
4) Statistics typically uses large amounts of data. This can present the learner with the problem of distinguishing the wood from the trees, so here principles will usually be illustrated using smaller data sets than are commonly encountered in real life. An apparent snag with this approach is that making an inference is a bit more complicated from a small sample than from a large one. But just as sailors find that handling their boats in the open sea is easier once they have learned the fundamentals in shallow waters, so will statisticians develop a deeper understanding of dealing with large samples once they have understood small ones. More maritime accidents happen in the shallows than in the deep!
5) While tests and examinations are obviously designed to assess your understanding, they should at the same time help you to learn.

SOME GOOD QUESTIONS

You can gain a statistician's respect – and avoid being "blinded with science"-- by asking the following. With application, you'll be able to assess her/his answers yourself by the time you've finished this book!

1) What do your methods assume about the distribution of the population?

2) When you say "significant", don't you mean "indicative" or "convincing" rather than "important"?

3) By "prediction", do you mean "inference" or "forecasting"?

4) When you talk of the "probability of being right", do you mean the probability of the truth given the evidence, or the probability of the evidence given the truth?

5) Standard texts give a lot of detail about "hypothesis testing". But how do you decide which is the "null hypothesis", and which the "alternative hypothesis"?

6) You've convinced me that even a small sample can yield valuable information about a population, but how would you choose the particular individuals for your sample?

7) In physics, we were taught when plotting graphs to put "cause" on the x-axis, and "effect" on the y-axis. But which is which when, for example, we plot people's height against their weight?

8) Further to (7), we often want to plot some variable against time, e.g. the stock market performance over the past year. Does that imply time is a "cause"? Isn't time different in nature from the other measures we use, such as height, speed, income, P/E ratio, scholastic attainment…?

9) I've seen references to "experiments on human beings" –surely these are ethically unacceptable?

10) I've seen statistics described as the "science of large amounts of data". We all know that computers are much better than human beings at number-crunching, so why bother learning statistics when we can leave it all to the IT experts?

SPECIMEN TEST/EXAMINATION QUESTIONS

1. Look up the *Kahneman and Tversky Cab* study on Google. All the following statements are true, but for which one do you need mathematics to confirm?

a) The general term for the 80% figure is *likelihood*, and untypically, is the same for both colours.
b) The general term for the 85% figure is the *prior probability* or *belief*.
c) One difficulty in using Bayes' theorem is that the prior should be independent of the likelihoods. This seems unlikely in this study; in her identification, the witness would surely be influenced by her knowledge of the prior. After all, it is a rare person who does not know that most cabs in New York are yellow!
d) In statistical terminology, the court were testing the null hypothesis that the guilty cab was blue, and so the Green cabs the witness wrongly identified during her test constituted what are more generally called Type I errors, and the wrongly-identified Blue cabs Type II.
e) Bayes' has relevance to such social problems such as *ageism*. There are ample grounds for the prior belief that people over 60 are more prone to illness and forgetfulness than those younger, but is an employer justified using these grounds when assessing any particular individual for a job?
f) The result – the chance that the witness was correct – can be expressed as either a probability of 41%, or of odds (against) of 12:29.

2. The following six individuals have made substantial contributions to inferential statistics: R.Fisher, K. Pearson, C. Gauss, W. Gosset, N. Taleb, T. Bayes. In an exam, you would find one name pen-annotated 'A', and a second name 'B'. Write an imaginary script for a television interview where A (or his ghost) critically interrogates B (or his ghost). [This yields 30 variants]