Book reviews, Winter 2012

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Book reviews, Fall 2012

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Abstract

This note is made of reviews of the books by Wilkinson (2011), Tu and Gilthorpe (2011), Wardhaugh (2012), Mackenzie (2012), Petersen (2012), and Doxiadis et al. (2009), respectively. They are scheduled to appear in the next issue (25(4)) of CHANCE.

The first two reviews are written by Sophie Donnet, in a comparative perspective. The following four reviews are written by Christian P. Robert.

Stochastic Modelling for Systems Biology (second edition) by Darren J. Wilkinson

- **Hardcover:** 335+xxvii pages
- **Publisher:** CRC Press
- **Language:** English
- **ISBN:** 978-1-4398-3772-6

Since I had to review both Wilkinson (2011) and Tu and Gilthorpe (2011) in the same period, I found interesting to propose a comparative review. Indeed, due to their common topic (roughly "statistics for biologists") they will surely end up of the same shelf of any bookstore or library but offer radically different points of view.

"Stochastic Modelling for Systems Biology" is the second edition of the book written by Darren J. Wilkinson in 2006. This book aims at filling in

the gap between biological publications evading stochastic modelling and stochastic processes books far away from any practical application on systems biology. Issued from a course the author gave on stochastic system biology to master's students in bioinformatics, this book tends to be self-content.

After a short but clear introduction to biochemical networks in Chapters 1 and 2, Chapters 3 to 5 aim at giving the minimal but essential background in probability, starting back from the definition of an event and ending at multivariate diffusion processes. The choice of the tackled notions is systems biology-oriented, resulting into a quite short, coherent and didactic probability course. All the mathematical proofs are given, just as to students in a class. The concepts are presented in their simplest form, in order to be directly applied to the simulation of chemical and biochemical kinetics (Chapter 6) and on case studies (Chapter 7). Chapter 8 proposes refinements and alternatives to the Gillespie algorithm first presented in Chapter 6. Chapter 9 introduces Bayesian Inference which is applied to the inference of biological systems in Chapter 10. All along the book, codes are given in R or in SBML.

About Systems Biology

The end of the Twentieth Century has witnessed the emergence of a new approach to biomedical research: Systems Biology. This inter-disciplinary field of research (involving biologists, mathematicians, statisticians, physicists, chemists) aims at studying "the interactions between the components of biological systems, and how these interactions give rise to the function and behavior of that system" (Wikipedia entry on *systems biology*).

The modelisation can take place at different levels. At the lower level (cell), one of the challenge can be to describe the mechanism involved in/on the genetic material (transcription, gene regulation for instance). At a higher level, the issue is to understand the functioning of a tissue, an organ. At the top level, the evolution of a population is a major topic.

Whatever the level is (cell, organ or population), the process of interest is written as a chemical equation and several graphical representation can be used. The study of quantitative features (such as concentration in biochemical networks) leads to models defined through dynamical systems (ordinary, partial, and delay differential equations or systems of equations).

However, those deterministic dynamical systems are so complex that the computational limits are quickly reached. To tackle that point, a solution may be to neglect some parts of the model and introduce a stochastic component (see chapter 1 of Wilkinson (2011) for a proper and didactic introduction).

The models used in Systems Biology involve many parameters and statistical inference is therefore a challenging issue that has fostered the emergence of likelihood-free methods.

Each chapter is completed by some training exercises. I wish any motivated student could use that book for self-study but maybe hints to the exercises would help these students. In order to satisfy more curious or more advanced readers, the author also proposes "further readings" in a dedicated section for each chapter, which is in my opinion a really good idea: highlighting a selection of interesting readings is much less disheartening than referring to a bibliography at the end of the book. Note that the book is supplemented by a quite complete website.

Between editions 1 and 2, the book has been enhanced by an introduction to Approximate Bayesian Computation (ABC, see the vignette in an earlier Book Reviews), the codes have been up-dated to SBML Level 3, the chapters on Markov chains and stochastic differential equations have been reinforced.

Many reviews of that book in its first edition were published in the communities of statistics (Haigh, 2007), bioinformatics (Schwartz, 2007), biomedical engineering (Bullinger, 2006), and mathematical biology (Burrage, 2006). There was a consensus on the fact that this book fulfills expectations, making a bridge between probability-statistics and systems biology: for instance, as stressed by Haigh (2007), the author reunifies the nomenclatures, identifying Kolmogorov forward and master equations. The opinions about the level of probability vary with the reviewers' community of origin: some of the reviewers found the level too low whereas others found it too high. From my point of view, this is the minimal level to reach to be able to understand and manipulate systems biology and this should not be skipped. Darren Wilkinson takes advantage of his teaching experience to propose a really comprehensible and easy-to-read course.

Further reading

Eric Bullinger. Review of "Stochastic Modelling for Systems Biology" by Darren J. Wilkinson. *BioMedical Engineering OnLine*, 5:64, 2006.

Kevin Burrage. Book review. "Stochastic Modelling for Systems Biology" by Darren J. Wilkinson. *Mathematical Medicine and Biology*, 23:391–392, 2006.

John Haigh. Book review. "Stochastic Modelling for Systems Biology" by Darren J. Wilkinson. *JRSS A*, 170(1):261, 2007.

Russell Schwartz. Book review. "Stochastic Modelling for Systems Biology" by Darren J. Wilkinson. *Briefings in Bioinformatics*, 8(3), 2007.

Statistical Thinking in Epidemiology by Yu-Kang Tu and Mark S. Gilthorpe

- **Hardcover:** 219+xii pages
- **Publisher:** CRC Press
- **Language:** English
- **ISBN:** 978-1-4200-9991-1

Yu-Kang Tu and Mark S. Gilthorpe adopt a radically different point of view, when compared with Wilkinson (2011). Assuming that the reader masters a substantial background on generalized linear models, the authors highlight some particular statistical situations in which current practices in clinical research are inadequate and require a deeper statistical thinking. In order to be more persuasive with non-mathematicians, they base their discussions on a geometric interpretation of the regression analysis and so are able to produce nice graphical illustrations.

Chapter 1 motivates the book and discusses the choice of the geometric approach which is developed in Chapter 2. Chapter 3 introduces Path Diagrams and DAG as a mean to visualize confounders, e.g. extraneous variables that correlates with both outcome and explanatory variables. It may be this chapter would be easier to read if, instead of treating a generic example (with variables X, Y, ...), a pseudo-real example was proposed with realistic variables (age, sex, weight...). Chapter 4 also tackles the problem of correlation between variables (mathematical coupling), however, when one tries to prove the efficiency of a treatment by regressing the value of the change in the state of the subject $(y-x)$ against its initial state x. In Chapter 5, the authors compare the statistical power of several statistical tests of changes in the pre-test / post test study. Chapter 6 tackles the problem of collinearity between explanatory variables and the authors assess their approach using the geometric interpretation of the regression exposed in Chapter 2. Lord's paradox is discussed in Chapter 7, whereas Chapter 8 reviews the methods to test statistical interaction. Chapters 9 and 10 are dedicated to the identification of critical growth phases in lifecourse research (e.g. "the study of long-term effects on chronic disease risk of physical and social exposures during gestation, childhood, adolescence, young adult and later adult life" Ben-Shlomo and Kuh, 2002).

After reading this book, I have the following comments.

1. As I stressed above, a very specific feature of that book is that many explanations rely on the geometrical interpretation of the regression analysis or of the correlation. That choice is discussed in the introduction *"[...] we believe vector geometry is a very useful tool for intuitive understanding of the basic concepts and nuances of linear models but we acknowledge that not all our readers will agree with us as some may not find thinking geometrically at all intuitive or helpful"*. Before reading this book, I was not used to manipulate such geometric tools and I found that approach really interesting. The graphical explanations proposed in that book are quite convincing and these tools should be more exploited in statistical classes.

2. As specified as well in the introduction, this book is not a textbook and can not be used as an introduction to epidemiology. The authors propose here a very large discussion on various paradoxes or controversial points. That choice really reduces the readership and excludes any reader who is not a specialist in epidemiology. In standard books or papers, the discussion is given at the end of the text and comes in after a large and hopefully didactic description of the context, the problem, and the suggested solutions. Here this part is reduced to its minimum and the reader is directly faced up with the controversial aspects. Being a non-specialist in epidemiology, I was quite a bit discouraged by that approach and I felt that I missed tools to be able to appreciate that book.

3. Moreover, I think that book should have a subtitle or at least a title that is less vague. Indeed, being so vague, on the one hand it will attract readers not specialised in epidemiology and disappoint them (as I was myself); on the other hand, I do not think it will attract easily epidemiologists because "Statistical Thinking" can mean nothing and everything at the same time. I would have preferred something like "Controversies in Epidemiology" or "Inadequate practice in epidemiology and solutions".

Finally I appreciated the efforts made by the authors in highlighting delicate points in epidemiology, however, contrary to the authors, I think that book would highly benefit from an introduction to epidemiology. Adding a quick introduction to standard problematics and reminding basics on regression analysis (introducing at the same time the geometric interpretation) would attract and encourage non-specialists and enlarge the audience.

A comparative review

As a conclusion, I found that the two books I had to review adopt two opposite approaches to the same field.

First, anecdotally, on the one hand Tu and Gilthorpe encourage the readers to use geometry and graphical representation. On the contrary, when Wilkinson introduces Petri nets and DAGs to visualize biological systems, he quickly goes back to their matrix form.

More fundamentally, both books both aim at improving the practice of statistics in a particular applied field. However, on the one hand, Wilkinson thinks that this improvement comes from a solid training in basic probability to be able to grasp the subtilities of the simulation of biology systems. As a consequence, his book is nearly self-content but a high-level practice would require the reading of additional texts. On the other hand, Tu and Gilthorpe propose a list a controversial points and the reading of that book should encourage practitioners to go back to their fundamentals and their assumptions to improve the statistical component of their work.

Further reading

Ben-Shlomo Y. and Kuh D. A life course approach to chronic disease epidemiology: Conceptual models, empirical challenges and interdisciplinary perspectives. *International Journal of Epidemiology*, 31:285–93, 2002.

The Universe in Zero Words by Dana Mackenzie

- **Hardcover:** 224 pages
- **Publisher:** Princeton University Press
- **Year:** 2012
- **Language:** English
- **ISBN-13:** 978-0691152820

The universe in zero words: The story of mathematics as told through equations is a book with a very nice cover: in case you cannot see the details on the picture, what looks like stars on a bright night sky are actually equations discussed in the book (plus actual stars!)...

The universe in zero words is written by Dana Mackenzie (check his website!) and published by Princeton University Press. (I received it in the mail from John Wiley for review, prior to its publication on May 16, nice!) It reads well and quick: I took it with me in the mtro one morning and was half-way through it the same evening, as *The universe in zero words* remains on the light side, esp. for readers with a high-school training in math. The book strongly reminded me (at times) of my high school years and of my fascination for Cardano's formula and the non-Euclidean geometries. I was also reminded of studying quaternions for a short while as an undergraduate by the (arguably superfluous) chapter on Hamilton. So a pleasant if unsurprising read, with a writing style that is not always at its best, esp. after reading Bill Bryson's *Seeing Further: The Story of Science, Discovery, and the Genius of the Royal Society* (reviewed in the previous issue of CHANCE, and a book unlikely to bring major epiphanies to the mathematically inclined. If well-documented, free of typos, and engaging into some mathematical details (accepting to go against the folk rule that "For every equation you put in, you will lose half of your audience" already mentioned in Diaconis and Graham's book, see my earlier review). With alas a fundamental omission in my very personal opinion: no trace whatsoever is found therein of Bayes' formula! (The very opposite of Bryson's introduction, who could have arguably stayed away from it.) The closest connection with statistics is the final chapter on the Black-Scholes equation, which does not say much about probability.... It is of course the major difficulty with the exercise of picking 24 equations out of the history of maths and physics that some major and influential equations had to be set aside Maybe the error was in covering (or trying to cover) formulas from physics as well as from maths. Now, rather paradoxically (?) I learned more from the physics chapters: for instance, the chapters on Maxwell's, Einstein's, and Dirac's formulae are very well done. The chapter on the fundamental theorem of calculus is also appreciable.

> *"On Babylonian mathematical tablets, the solution to a problem was never complete until the solver wrote, Praise Nisaba!" at the end." (page 8)*

The book is very well-versed in the ancient history of mathematics, from Babylonian to Chinese mathematicians, in addition to the more well-known Greeks. (It clearly borrowed from the extensive bibliography on the history of mathematics provided at the end.) This led to one of the most exciting discoveries in the book namely that for Chinese mathematicians, the Pythagorean theorem is called the gou-gu theorem (anyway to turn

into LaTeX?) [no surprise with an alternative name!], but also that the hypotenuse is called *xian*, meaning "lute string"! I am very pleased that my pseudonym has a mathematical meaning as well!!

While the illustrations in this *universe in zero words* are numerous (no word but many pictures!) and to the point, I have two issues: the main one is the choice of using handwritten representations of the equations motivating each chapter. This is pretty and has an historical feel, but it makes some of the equations harder to read (some symbols were actually ambiguous enough to make me go back to the text to make sure I understood!) and it somehow looks less rigorous. My second issue is that the book did not make use of the mathematicians' wordprocessing LaTeX for composing equations, hence resulting in a rougher and less satisfying typographic outcome. (This may only appeal to the professional mathematician, but since the book is rightly preoccupied with the beauty of equations, using a proper mathematical software should have mattered! This remark is also apologetic towards the future rendering of this review in CHANCE since the commercial editor of the journal also refrains from using LaTeX!!!)

> *"A great equation tells us something that we did not know before (...) A great equation has the spare aesthetic of Japanese calligraphy." (page 6)*

If you can bear with me a wee longer, I would like to get over the various formulae proposed through the book. Some of those are definitions, like $1+1=2$, $1-1=0$, $\pi = 3.1415926535...$, $\exp(ix) = \cos(x) + i\sin(x)$, which, despite providing natural entries to a wealth of mathematical concepts and discoveries, do no necessary "tell us something new". Others are approximations like the definition of π, or Gauss' prime number theorem. Or conjectures, like Riemann's and the Continuum Hypotheses, now that Fermat's Theorem is out of the way! And, as mentioned above, (too) many are physics equations: Archimedes' lever law, Kepler's planet laws, Newton's gravitational laws, Maxwell's, Einstein's, and Dirac's formulae, Lorentz's equations. There are many good stories arising from those, but the book still make a choice of the most standard characters, from Newton, to Fermat, to Galois, to Einstein, and of the most popular stories, with the apparently unavoidable Gödel (and Whitehead and Russell) appearing twice. (As detailed below, I do prefer the introduction provided by *Logicomix*, obviously, even though all formulae are botched in the drawings! And I am not highly excited by the Continuum Hypothesis, I must say...) The absence of Laplace, even more than of Bayes, is felt in the book. Anyway, enough grumbling: *The universe in zero word: The story of mathematics*

as told through equations makes for an easy and pleasant read, as well as a wonderful gift for mathematically inclined (and English speaking) teenagers.

Simulating Nature by Arthur C. Petersen

- **Hardcover:** 224 pages
- **Publisher:** Chapman and Hall/CRC (second edition)
- **Year:** 2012
- **Language:** English
- **ISBN-13:** 978-1466500624

This book, *Simulating Nature: A Philosophical Study of Computer-Simulation Uncertainties and Their Role in Climate Science and Policy Advice*, by Arthur C. Petersen, was sent to me twice by the publisher for reviewing it for CHANCE. As I could not find a nearby victim" to review the book, I took it with me to Australia and read it by bits and pieces along the trip.

> *"Models are never perfectly reliable, and we are always faced with ontic uncertainty and epistemic uncertainty, including epistemic uncertainty about ontic uncertainty." (page 53)*

The author, Arthur C. Petersen, was a member of the United Nations' Intergovernmental Panel on Climate Change (IPCC) and works as chief scientist at the PBL Netherlands Environmental Assessment Agency. He mentions that the first edition of this book, *Simulating Nature*, has achieved some kind of cult status, while being now out of print, which is why he wrote this second edition. The book centres on the notion of uncertainty connected with computer simulations in the first part (pages 1-94) and on the same analysis applied to the simulation of climate change, based on the experience of the author, in the second part (pages 95-178). I must warn the reader that, as the second part got too focussed and acronym-filled for my own taste, I did not read it in depth, even though the issues of climate change and of the human role in this change are definitely of interest to me. (Readers of CHANCE must also realise that there is very little connection with Statistics in this book or my review of it!) Note that the final chapter is actually more of a neat summary of the book than a true conclusion, so a reader eager to get an idea about the contents of the book can grasp them through the eight pages of the eighth chapter.

"An example of the latter situation is a zero-dimensional (sic) model that aggregates all surface temperatures into a single zero-dimensional (re-sic) variable of globally averaged surface temperature." (page 41)

The philosophical questions of interest therein are that a computer simulation of reality is not reproducing reality and that the uncertainty(ies) pertaining to this simulation cannot be assessed in its (their) entirety. (This the inherent meaning of the first quote, epistemic uncertainty relating to our lack of knowledge about the genuine model reproducing Nature or reality) The author also covers the more practical issue of the interface between scientific reporting and policy making, which reminded me of Christl Donnelly's talk I attended at the ASC 2012 meeting in Adelaide (about cattle epidemics in England). The book naturally does not bring answers to any of those questions, naturally because a philosophical perspective should consider different sides of the problem, but I find it more interested in typologies and classifications (of types of uncertainties, in crossing those uncertainties with panel attitudes, &tc.) than in the fundamentals of simulation. I am obviously incompetent in the matter, however, as a nave bystander, it does not seem to me that the book makes any significant progress towards setting epistemological and philosophical foundations for simulation. The part connected with the author's implication in the IPCC shed more light on the difficulties to operate in committees and panels made of members with heavy political agendas than on the possible assessments of uncertainties within the models adopted by climate scientists... With the same provision as above, the philosophical aspects do not seem very deep: the (obligatory?!) reference to Karl Popper does not bring much to the debate, because what is falsification to simulation? Similarly, Lakatos' prohibition of "direct[ing] the modus tollens at [the] hard core" (page 40) does not turn into a methodological assessment of simulation praxis.

"I argue that the application of statistical methods is not sufficient for adequately dealing with uncertainty." (page 18)

"I agree (...) that the theory behind the concepts of random and systematic errors is purely statistical and not related to the locations and other dimensions of uncertainty." (page 55)

Statistics is mostly absent from the book, apart from the remark that statistical uncertainty (understood as the imprecision induced by a finite amount of data) differs from modelling errors (the model is not reality), which the author considers cannot be handled by statistics (stating that

Deborah Mayos theory of statistical error analysis cannot be extended to simulation, see the footnote on page 55). [In other words, this book has no connection with Monte Carlo Statistical Methods! With or without capitals... Except for a mention of 'real' random number generators on–one of many–footnotes on page 35.] Mention is made of subjective probabilities" (page 54), presumably meaning a Bayesian perspective. But the distinction between statistical uncertainty and scenario uncertainty which .cannot be adequately described in terms of chances or probabilities" (page 54) misses the Bayesian perspective altogether, as does the following sentence that 'specifying a degree of probability or belief [in such uncertainties] is meaningless since the mechanism that leads to the events are not sufficiently known" (page 54).

> *"Scientists can also give their subjective probability for a claim, representing their estimated chance that the claim is true. Provided that they indicate that their estimate for the probability is subjective, they are then explicitly allowing for the possibility that their probabilistic claim is dependent on expert judgement and may actually turn out to be false." (page 57)*

In conclusion, I fear the book does not bring enough of a conclusion on the philosophical justifications of using a simulation model instead of the actual reality and on the more pragmatic aspects of validating/invalidating a computer model and of correcting its imperfections with regards to data/reality. I am quite conscious that this is an immensely delicate issue and that, were it to be entirely solved, the current level of fight between climate scientists and climatoskeptics would not persist. As illustrated by the "Sound Science debate" (pages 68-70), politicians and policy-makers are very poorly equipped to deal with uncertainty and even less with decision under uncertainty. I however do not buy the (fuzzy and newspeak) concept of "post-normal science" developed in the last part of Chapter 4, where the scientific analysis of a phenomenon is abandoned for decision-making, "not pretend[ing] to be either value-free or ethically neutral" (page 75).

A Wealth of Numbers by Benjamin Wardhaugh

- **Hardcover:** 388 pages
- **Publisher:** Princeton University Press
- **Year:** 2012

- **Language:** English
- **ISBN-13:** 978-0691147758

Another general audience book sent to me by Princeton University Press! This *Wealth of Numbers* is a compilation of one hundred texts on mathematics for the general audience, à la Martin Gardner but starting in 1481! Very few well-known authors in this compilation, apart from Voltaire, Euler, Carroll, Pólya, van der Waerden, Shaw, Rademacher, Toeplitz. and Feynman... I must acknowledge I did not read each entry in detail over breakfast, either by laziness about getting into old English style or because the topic was not of direct interest to me. This however leads me to wonder who would appreciate the book. The styles and contents are quite mixed, from puzzles to historical entries, to older and newer ways of introducing basic notions, to science-fiction (for the very last entry) [if not Anathem!, reviewed in my first CHANCE column]... A linear reader, going from page 1 to page 365, must thus be quite open-minded if this reader does not want to skip anything. The book can however be seen as a terrific source for short illustrations in talks and classes.

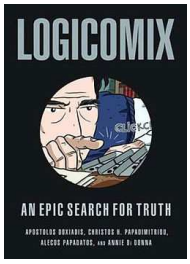
A few gems I appreciated (some for highly personal reasons!): the wrong resolution of a probability problem by (the highly obscure or even imaginary) L. Despiau in 1801 (page 19) [which makes me regret the absence of a critical postface to the texts, so that they could be replaced into a larger context and straightened out if necessary!]; from a contemporary of Bayes, Banson's 1760 way of extracting square roots (page 46); Wells' 1714 limpid introduction to trigonometry (page 94) that reminded me very much of the way my daughter was taught the same a few weeks ago; Ball's 1892 reproduction of Kempe's false proof of the four-colour theorem (page 118); a 1561 entry on maritime maps by Martin Cortés, son of the conquistador Hernán Cortés (pages 153-154); Patridge's 1648 description of Napier's speaking rods" (also known as Napier's bones", page 157) that reminded me of my slide rule in high school (that I learned to use the year before the pocket calculator was allowed at exams, just like the pinched cards I had to handle the year before terminals got accessible in my statistics graduate school!); Voltaire's amazing 1733 eulogy of Newton, against Leibniz and Bernoulli (page 178); Eicholz' and O'Daffer's 1964 explanation of set theory axioms within the "New Math" pedagogy, just a few years before I learned them in primary school (pages 278-281); LOGO programming on the Spectrum 48K (!) by Gascoigne in 1985 (pages 282-289), quite in tune with the LISP and ADA programing languages my wife was learning at the time in EE graduate school, while I

stuck to Pascal...; Playfair's 1798 chart of exchange balance between England and Ireland (page 306) and the only place in the book where statistics is mentioned; Richard Feynman's very honest acknowledgement of the primacy of mathematics, even though he wished it could be different (pages 320-321). I am sure other readers would find at least as much entries in *A Wealth of Numbers*, if not necessarily the same ones, to their taste.

As you can judge from the above, the book also has a very nice cover, by Eugen Jost, relating to Hardy's taxi number, the not-so-dull 1729. (And a nice picture of the author in the back flap, taken in a place reminiscent of Scotland, even though it could as well be the Yorkshire dales or the Lake District.)

Logicomix: An Epic Search for Truth by A. Doxiadis, C. Papadimitriou, A. Papadatos, and A. Di Donna

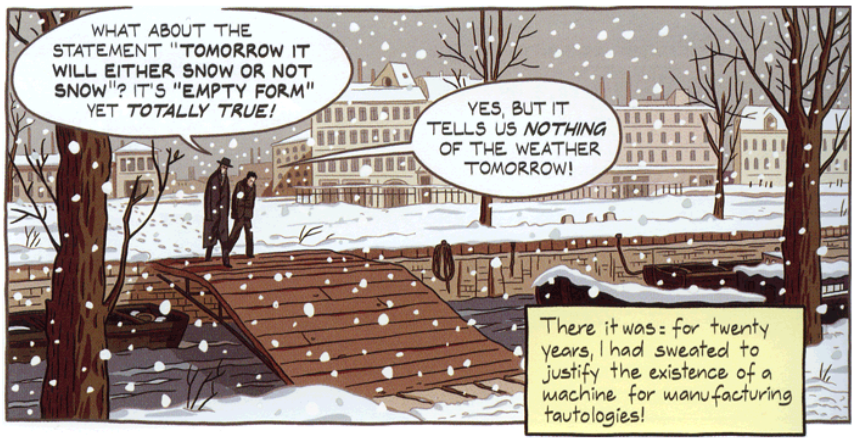
- **Hardcover:** 352 pages
- **Publisher:** Bloomsbury USA
- **Year:** 2009
- **Language:** English
- **ISBN-13:** 978-1596914520



The above review of *The Universe in Zero Words* reminded me that I enjoyed very much *Logicomix: An epic search for truth* when I read it two years ago. (Someone else obviously enjoyed it as well as I cannot find my two copies!) This book is (most unusually for an history of sciences book) written in the format of a comic book. (The style of the drawings is rather classical, with a standard use of panels and balloons.)

This (bestselling) book is about Bertrand Russells doomed quest for the logical foundations of mathematics and the related and intense debates that took place within the philosophical and mathematical communities at the turn of the century, ending with Gödel's incompleteness theorem and Wittgenstein's *Tractatus Philosophicus*. (Which reminded me of another highly interesting

book, *Wittgenstein's poker*, Edmonds and Eidinow, 2001, that I read eons ago.)



Now, let me warn CHANCE readers who had not yet read it that *Logicomix* is not that deep a story, obviously, thus is more prone to awake interest into a young or neophyte reader rather than satisfy a more senior mathematician. There is a limit to the amount of abstraction one can carry through a comic panel. Even with a high text-to-grahic ratio. Nonetheless, the progression of the philosophers' reasoning almost has a thriller quality that is quite addictive! As a minor aside, I find the inclusion of the debates and questionnings of the authors of the book within their own book and about their own book a bit annoying (or worse if this is intended as an heavy-duty illustration of self-referential concepts!), but this only represents a small portion of the whole book. I also appreciated the way *Logicomix* deals with the borderline sanity of most actors involved in this dangerous game, even though some parts are rather caricaturesque, like Russell letting his son to almost drown as a lesson in self-control! (The book has been translated in many languages, French included.)

A strange thing, though, is the use of utterly meaningless mathematical formulae in the drawings. For instance,

$$\frac{e\omega}{\eta\cos\mathrm{PSM}'}$$

or

$$\frac{\partial^n F(y)}{\partial x_i^n} = \frac{1}{h!}\sum_{i=1}^{\infty}\int F^n(x_i)\mathrm{d}x_i$$

certainly make not sense whatsoever... This is weird given that the two writers, Doxiadis and Papadimitriou, have enough of a mathematical background to realise that this non-sense is bound to annoy mathematicians! (It feels like watching a movie where someone plays the piano and the music is completely different, which always annoys me!)

In conclusion, this is a book I have now recommended to many over the years, mathematicians and non-mathematicians alike, and I take this opportunity to enlarge the circle of this recommendation. Unless you are completely adverse to comics, you should enjoy some aspects of it!

Further reading

Edmonds, E. and Eidinow, J. (2001). *Wittgenstein's Poker: The Story of a Ten-Minute Argument Between Two Great Philosophers*. Ecco.

About the Authors

Sophie Donnet is an assistant professor of statistics at Université Paris-Dauphine since 2007, after having studied Mathematics and Statistics at University Paris-Sud, Orsay. Her research interests include the inference of dynamical systems (ODE or SDE models, branching processes), the construction or elicitation of prior distributions in Bayesian context with application to reliability, food risks, neuroimaging.

Christian P. Robert is a professor of statistics at Université Paris-Dauphine, France. He has written extensively about Bayesian statistics and computational methods, including the books *The Bayesian Choice* and *Monte Carlo Statistical Methods*. He has served as president of the International Society for Bayesian Analysis and editor in chief of the *Journal of the Royal Statistical Society* (Series B).