Pop Statistics Books and Statistical Education

Kaiser Fung[1]
[1]New York University, 7 E 12th Street, New York, NY 10003

Abstract
Recently, pop-stats books have captured the public's favor, overcoming the negative perception of the subject of statistics. The best known examples include the Malcolm Gladwell series; the *Freakonomics* franchise; Ian Ayres's *Super Crunchers*; and my own contribution, *Numbers Rule Your World*. Readers find these books highly accessible as each author finds a way to balance readability and rigor. What can educators learn from this publishing phenomenon? What is the role of pop-stats books in statistics courses?

Keywords: Popular statistics, Publishing, Curriculum, *Freakonomics*, Books, Education

1. Introduction

The success of pop-stats books in particular, and of popular science books in general, has been a bright spot amidst the doom and gloom in the book publishing industry. Starting with Malcolm Gladwell's *The Tipping Point* (published in 2000), readers have embraced non-fiction books with substantive statistical contents, such as *Freakonomics* (Levitt and Dubner, 2005), *The Black Swan* (Taleb, 2007), *Super Crunchers* (Ayres, 2007), and *The Drunkard's Walk* (Mlodinow, 2009). Table 1 lists the representative titles, most of which were published in the past decade. A variety of publishers have brought out titles in this genre.

Table 1: Some representative titles in the pop-stats genre

Title	**Author**	**Publisher**	**Year Published**
The Tipping Point	Malcolm Gladwell	Little, Brown	2000
Fooled by Randomness	Nassim Taleb	W.W. Norton	2001
Dicing with Death	Stephen Senn	Cambridge	2003
Blink	Malcolm Gladwell	Little, Brown	2005
Freakonomics	Steven Levitt and Stephen Dubner	William Morrow	2005
Struck by Lightning	Jeffrey Rosenthal	HarperCollins	2005
Chances Are…	Michael and Ellen Kaplan	Viking	2006
The Black Swan	Nassim Taleb	Random House	2007
Super Crunchers	Ian Ayres	Bantam	2007
Outliers	Malcolm Gladwell	Little, Brown	2008
Predictably Irrational	Dan Ariely	Harper	2009
SuperFreakonomics	Steven Levitt and	William Morrow	2009

	Stephen Dubner		
The Drunkard's Walk	Leonard Mlodinow	Knopf	2009
The Upside of Irrationality	Dan Ariely	Harper	2010
The Flaw of Averages	Sam Savage	Wiley	2009
Numbers Rule Your World	Kaiser Fung	McGraw-Hill	2010
Proofiness	Charles Seife	Viking	2010

Since the top of this group has sold millions of copies, there is little doubt that the buyers include not only self-selected geeks but also business and general readers. This success comes as a welcome surprise to those of us involved in statistical education, for the subject of statistics has hitherto been received with fear, disinterest, and even repulsion. The most popular and exemplary of these books are the franchises by Malcolm Gladwell and the *Freakonomics* team. A comparison of these bestsellers with other books in the same genre that appeared before reveals a drastic change in the formula for constructing a pop-stats book. Evidently, the emergent second generation achieves a markedly higher level of readability.

2. The First Generation

Traditionally, the pop-stats author interprets her role as making the first course of statistics accessible to general readers. While she keeps the number of equations to a minimum, the structure of these books follows closely that of an introductory statistics course; the illustrative examples mostly arise from the standard set, including such classics as the birthday problem, the urn problem and the Monty Hall problem.

This formula is proven, and reproduced every few years. A recent, impressive example is *The Drunkard's Walk* by Leonard Mlodinow, who delivers the contents nicely packaged in an entertaining style. That said, one can readily identify a direct mapping between the table of contents of *The Drunkard's Walk* and the syllabus of a first course in statistics, as shown in Table 2.

Table 2: Direct mapping between the contents of *The Drunkard's Walk* and the typical syllabus of a first course in statistics

Chapter	Table of contents (abridged)	Intro Stats Syllabus
1	Peering through the Eyepiece of Randomness …	Introduction
2	The Laws of Truths and Half-truths…	Rules of probability
3	Finding Your Way through a Space of Possibilities…	Sampling
4	Tracking the Pathways to Success…	Combinatorics
5	The Dueling Laws of Large and Small Numbers…	Law of Large Numbers
6	False Positives and Positive Fallacies…	Conditional probability
7	Measurement and the Law of Errors…	Central Limit Theorem
8	The Order in Chaos…	Regression to the mean
9	Illusions of Patterns and Patterns of Illusion…	Hypothesis testing
10	The Drunkard's Walk…	Conclusion

While such a format has achieved success with science readers, it has not made inroads with other audiences. This situation changed with the arrival of the Gladwell and *Freakonomics* series.

3. The Second Generation

The defining characteristic of the second generation of pop-stats books is their much-lauded readability. Gladwell, Levitt and Dubner, and others perceive their role to be the entertainer rather than the educator: through skilful telling of real-world stories, these authors demonstrate how smart data analyses deliver unexpected insights, without ever showing the mathematics leading to those insights. Keeping the flow of the narrative is paramount. By contrast, the first-generation authors frequently function as translators of mathematical language into English.

The second generation drops any pretense of delivering an entire course load, preferring a sharper focus on selected topics. Staying away from the classic textbook examples, these writers present real-world scenarios in which statistical analyses uncover significant, and often startling, insights. For example, Levitt and Dubner investigated why the crime rate in the U.S. dramatically dropped in the 1990s, showing readers how econometricians determined the effect of abortion legislation relative to those of other policies such as enlarging the police force. They, however, never presented any regression equation used in the analysis.

The following explanation of regression analysis, snipped from the ground-breaking *Freakonomics*, serves as a reminder of the intention of the second generation:

> No, regression analysis is not some forgotten form of psychiatric treatment. It is a powerful – if limited – tool that uses statistical techniques to identify otherwise elusive correlations.

The casual tone and imprecision of the statement is alien to the first-generation authors, who deal with the *foundations* of statistics: the Law of Large Numbers, the Central Limit Theorem, regression to the mean, and so on. When Gladwell entered the scene, he shifted the central concern of pop-stats books to *insights*. This bold move has made huge waves in the market for pop-stats books. Books such as *Freakonomics*, *The Black Swan*, and *Predictably Rational* (Ariely, 2009) all interpret the insights-centric paradigm in their own way.

On the surface, many of these do not appear as books about statistics but their deep connection to statistics is undeniable, and they provide a practical setting under which important statistical concepts are explored and explained. The concepts include experimental design, data cleansing, regression analysis, causal inference, stochastic modeling, and so on.

4. Towards a Third Generation

As a practitioner, I applaud the rise of the second generation of pop-stats books, and yet harbor some apprehension about the direction this takes us. I worry about the desire for insights for the sake of insights.

We owe much gratitude to the second generation for developing a formula that makes statistical content palatable to the general audience, and for making statistics "sexy", to borrow from Hal Varian, the chief economist at Google and former Berkeley professor. In the business world, in particular, this renewed interest in quantitative thinking has yielded new job functions such as business analytics and data science.

However, as practitioners are well aware, insights is not the end-product of an analytics project. To truly realize the value of statistics, we must turn insights into actions, and measurable results.

It is here where the second-generation writers offer little. Take the counter-intuitive insight that abortion legislation could have significantly reduced crime, probably because children who would more likely have grown up to become criminals might have been aborted. This startling result was widely reported and debated in the mass media when *Freakonomics* first appeared. Nevertheless, the insight has had no impact on public policy, nor could it ever.

Similarly, the *Freakonomics* team reported the fascinating discovery that economists with surnames near the front of the alphabet have a higher chance of winning the Nobel Prize than other economists – a small but statistically significant effect, but having this knowledge will not change anyone's fortunes.

Thus, one hopes that the pop-stats genre will soon hatch a third generation, with the focus shifting from insights to actions.

Practitioners understand that insights are easy but actions are hard. Michael Lewis (2004) captures brilliantly the culture crash of decision-making modes between number crunching and intuition. In *The Upside of Irrationality*, behavioral economist Dan Ariely laments his inability to convince CEOs to take his experimental findings on executive compensation seriously. We encounter this type of situation frequently in practice.

Turning statistical insights into actions that produce results requires a diverse set of skills, particularly intangible skills. The rate of success is regrettably rather poor. This is all the more reason to examine the factors affecting the chance of success.

5. The Other Side of Readability

In order to make technical materials accessible to the average reader, second-generation authors have to balance carefully the demands of readability and scientific rigor. As mathematical language is sacrificed, so a certain degree of imprecision must be accepted. Carried away by the allure of counter-intuitive findings, authors sometimes lapse into shoddy logic.

As enthusiasts of the second generation, Andrew Gelman and I have reviewed the books, articles and blog posts of the *Freakonomics* franchise, and concluded that these materials are well worth reading, but one should read (or re-read as it may) with care. (A separate paper is in preparation.)

The central argument of a chapter in *SuperFreakonomics* about using smart data analysis to predict terrorists pivots around this assertion (with my italics):

> Horsley was able to generate a list of about 30 highly suspicious individuals. According to his rather conservative estimate, at least 5 of those 30 are almost certainly involved in terrorist activities. *Five out of 30 isn't perfect* -- the algorithm misses many terrorists and still falsely identified some innocents -- but *it sure beats 495 out of 500,495*.

Horsley is the pseudonym used to hide the analyst's identity. His statistical methodology tags 30 out of 50 million people as terrorist suspects, of which five would be true positives. By this measure (positive predictive value), Horsley has indeed much improved upon the straw-man algorithm. The authors describe Horsley's method as "great". In a blog post, I discuss why this conclusion misleads readers (with my italics):

> The casual computation kept under wraps the rate at which [Horsley's algorithm] failed at catching terrorists: *with 500 terrorists at large, the "great" algorithm found only five of them, and let pass the other 495*. ... Had they carried the analysis to its full, they would have realized that the maligned straw-man algorithm, by contrast, would have correctly identified 495 of 500 terrorists.

In other instances, the authors make a mess of some careless language. For example, in a connecting passage used in a vignette revealing how the assignment of kids to age groups could affect their probability of achieving athletic success, Levitt and Dubner remark (with my italics):

> A U.S.-born boy is roughly *50 percent more likely to make the majors* if he is born in August instead of July. Unless you are a big, big believer in astrology, it is hard to argue that someone is *50 percent better at hitting a big-league curveball* simply because he is a Leo rather than a Cancer.

One doesn't need a statistics degree to realize that the two probabilities being referenced are not identical. In such competitive situations, the gap between someone who makes the majors and someone who doesn't is tiny, nowhere near 50 percent. A 50-percent differential in batting averages would, for example, be between 0.200 and 0.300.

6. Conclusion

The confirmation of the pop-statistics genre is tremendously exciting news for anyone involved in statistical education. The more people read these books, the more our society understands the value of smart data analysis using statistics. Now, businesses like Google publicly declare their drive for statistical talent. Best-sellers like *Blink* and *Freakonomics* serve frequently as the primary sources of information about statistical thinking for general readers. This second generation of pop-stats books has completely changed how such books are structured and written. The positive impact of these changes is evident to all.

The perception that these books are "easy reads" is potentially dangerous because of the unavoidable trade-off between readability and scientific rigor. I recommend that readers enjoy these texts but read them with care, looking out for cases of sloppy logic and careless language.

The market has room for multiple points of view. The first generation of pop-stats books, those focusing on the foundations of statistics, will continue to attract serious readers.

The second generation, with its counter-intuitive insights, is proven to have mass appeal. One hopes that a third generation, shifting the focus from insights to actions, will emerge and gain acceptance.

Acknowledgments

The work presented in Section 5 of this paper was done in collaboration with Andrew Gelman.

References

Ariely, Dan. 2009. Predictably Irrational: The Hidden Forces that Shape Our Decisions. New York, NY: Harper.

Ariely, Dan. 2010. *The Upside of Irrationality: The Unexpected Benefits of Defying Logic*. New York, NY: Harper.

Ayres, Ian. 2007. *Super Crunchers: Why Thinking-by-Numbers is the New Way to be Smart.* New York, NY: Bantam.

Fung, Kaiser. 2010. *Numbers Rule Your World: The Hidden Influence of Probability and Statistics on Everything You Do.* New York, NY: McGraw-Hill.

Fung, Kaiser. 2010, March 15. Guest Post: Kaiser Fung. In: International Institute for Analytics blog. http://iianalytics.com/2010/03/732/

Gladwell, Malcolm. 2005. *Blink: The Power of Thinking Without Thinking*. London, UK: Little, Brown and Company.

Gladwell, Malcolm. 2008. *Outliers: The Story of Success*. London, UK: Little, Brown and Company.

Gladwell, Malcolm. 2000. *The Tipping Point: How Little Things Can Make a Big Difference*. London, UK: Little, Brown and Company.

Kaplan, Michael, and Ellen Kaplan. 2006. *Chances Are…: Adventures in Probability.* New York, NY: Viking Adult.

Levitt, Steven D., and Stephen J. Dubner. 2005. *Freakonomics: A Rogue Economist Explores the Hidden Side of Everything*. New York, NY: William Morrow.

Levitt, Steven D., and Stephen J. Dubner. 2009. *SuperFreakonomics: Global Cooling, Patriotic Prostitutes, and Why Suicide Bombers Should Buy Life Insurance*. New York, NY: William Morrow.

Lewis, Michael. 2004. *Moneyball: The Art of Winning an Unfair Game*. New York, NY: Norton.

Mlodinow, Leonard. 2009. *The Drunkard's Walk: How Randomness Rules Our Lives*, New York, NY: Knopf Doubleday Publishing Group.

Rosenthal, Jeffrey S. 2005. *Struck by Lightning: The Curious World of Probabilities*. Toronto, Canada: HarperCollins Canada.

Savage, Sam. 2009. *The Flaw of Averages: Why We Underestimate Risk in the Face of Uncertainty.* New York, NY: Wiley.

Seife, Charles. 2010. *Proofiness: The Dark Arts of Mathematical Deception*. New York, NY: Viking Adult.

Senn, Stephen. 2003. *Dicing with Death: Chance, Risk and Health.* Cambridge, UK: Cambridge University Press.

Taleb, Nassim N. 2007. *The Black Swan: The Impact of the Highly Improbable*. New York, NY: Random House.

Taleb, Nassim N. 2001. *Fooled by Randomness: The Hidden Role of Chance in Life and in the Markets*. New York, NY: W.W. Norton.