The Left Atrium

Steeped in statistics

The lady tasting tea: how statistics revolutionized science in the twentieth century
David Salsburg
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In 1847 the newly formed American Medical Association made a courageous commitment to the slowly developing field of bioscience, rejecting the popular heterodoxies of the day. Its Code of Ethics stipulated that "No one can be considered as a regular practitioner, or a fit associate in consultation, whose practice is based on an exclusive dogma (i.e., homeopathic beliefs), to the rejection of the accumulated experience of the profession and of the aids actually furnished by anatomy, physiology, pathology, and organic chemistry (i.e., a regular medical education)."

The successful alliance of "bed and bench" eventually produced modern medicine, but as its wonders were unfolding, a very different scientific discipline — statistics — steadily attached itself to the work of medicine and ultimately came to sit in judgement on it. (The word "statistics" originally applied to the collection of data for the "state" in the late 18th century.) In our time, statistics has achieved a public acceptance that any basic science can envy.

David Salsburg's book is a well-written intellectual and personal history of the men and women who developed the theoretical models for dealing with probability and the analytical tools for interpreting the numerical results of population studies and clinical trials. Although the book covers the role of statistics in all sciences, Salsburg, himself a medical statistician, includes sympathetic portraits of the semi-heroic figures familiar to physicians who have taken a statistics course or perused a textbook — Pearson, Fisher, Neyman, "Student," Tukey and many others.

Not a single formula interrupts the text of *The Lady Tasting Tea*. On the whole, this strategy suits the author's intent to reach readers already somewhat familiar with the uses of *t*-tests, chi squares, multiple regressions, analyses of variance and Fisher's exact text — this last, the method that R.A. Fisher reputedly invoked on one long English summer evening to test the claim of an acquaintance that she could distinguish between tea to which milk had been added and tea that had been poured into the cup after the milk.

Fred Sebastian

On a deeper level, the book is a forceful assertion that statistics has "arrived" as a theoretical and applied science. Salsburg hopes that "the reader will come away with some understanding of the profound shift in basic philosophy that is represented by the statistical view of science." For Salsburg, Karl Pearson discovered that "the real 'things' of science were not things that we could observe and hold but mathematical functions that described the randomness of what we could observe." Several chapters of the book are devoted to a very general description of the complex mathematical models that lie behind "statistical thinking," especially in the theoretical and multidimensional work of Kolmogorov.

Salsburg frequently admonishes the lay reader that even medical statistics has an abstruse theoretical base. He sketches out a world view that soars from the ground-level probability distributions that Karl Pearson described around 1900 to the attic of abstraction, even invoking Heisenberg's uncertainty principle and fuzzy logic, a world view that seems alien to the mindset of biomedical researchers grimly digging in the inductive basement for Yes or No answers.

As a practising medical statistician, Salsburg is well aware of the "Achilles heel" issues in statistics as applied to medical trials. He has written articles fine-tuning and even "demolishing" some of the underlying assumptions of the Neyman–Pearson approach to statistical analysis that has become reflexive in reporting clinical trials.[2]

For example, he calls the "intent-to-treat" rules of evaluating every patient assigned to a treatment group, even if they did not receive the treatment, "a very strange method of analysis," supporting this affront to orthodoxy in a short chapter. He seems to honour Fisher's opinion that significance testing can be used only in randomized experiments and voices his disagreement with the rigid Neyman–Pearson requirement of setting a cut-off *p* value (for both alpha and beta) in advance.

The Lady Tasting Tea is not a study of the acceptance and impact of statistical techniques in clinical research. It neither details the enormous benefits

that controlled trials have bestowed in fingering ineffective treatments and in sanctioning truly effective long-term treatments and preventive strategies, nor dwells on the shortcomings of clinical trials that this reader hoped would be more fully exposed: the lust for large numbers to crown small effect sizes with "significance"; the piebald heterogeneity of multicentre trials; the overuse, in almost every report, of statistical analysis; the false attribution of causality; and the careless notion that there is such a "thing" as randomness.

The American Medical Association's decision in 1847 was vigorously opposed by some influential medical teachers on two grounds: first, that the substitution of "physiological therapeutics" for the physician's exercise of judgement would diminish the physician's role as a healing presence and reduce his opportunity to individualize treatment; second, that a gap between the basic sciences and the daily practice of medicine would widen into a chasm that would be impossible for an individual — or an idea — to bridge. Clinical research would be foreshortened or abandoned; the laboratory would be the only source of new knowledge. These ancient cavils still resonate today, as clinical research and laboratory science proliferate.[3]

Concerns about the co-opting of the physician's judgement and the imposition of a new, alien discipline may apply with equal or greater force to medical statistics. The results of a clinical trial position the patient as a point in a probability distribution constructed by inductive logic. The resulting rules of evidence-based medicine constrict the physician's options for individualizing treatment, whereas the physician of 1910 could at least open Osler's textbook to deduce what would be best for his patient. It seems to me that the gap in training and mentality between the physician and the statistician is far greater than that between Claude Bernard, pioneer of physiology, and the practising physician of his day.

The Lady Tasting Tea is highly recommended as "cultural" reading for anyone involved in clinical trials. Salsburg has given faces and voices to some of the people who created medical statistics, and in so doing reminds us that there is much in their theories that we may not be applying wisely, or do not understand.

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References

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2. Salsburg D. The use of statistical methods in the analysis of clinical studies. *J Clin Eidemiol* 1993;46:17-27.
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Past progressive

Lying in

When my grandmother, Anne Dawson Webb, passed away in September 2000 at the age of 90 my parents dispersed her belongings to family members and the Salvation Army. Among the teacups and knick-knacks destined for the latter was an old book that caught my eye: *The Bride's Book — A Perpetual Guide for the Montreal Bride*, published in 1932. I felt compelled to rescue it.

Thumbing through the table of contents, I mulled over the chapter titles. Some topics were expected: "Cook Book of Tested Recipes," "The Art of Entertaining" and "Health and Beauty Hints." More intriguing were "Mystic Art of Tea Cup Reading" and "Poisons and their Antidotes." (Was the emphasis on poisoning, or on antidotes, I wondered.) Then I saw the chapter I knew I would read first: "What an Expectant Mother Should Know." As a doula practising 70 years after *The Bride's Book* was written, I wondered what women of my grandmother's day would have been told about childbirth. And, as I began to read, I felt as if I were witnessing my grandmother's own experience.

When she arrived at the maternity hospital, a woman in labour would have been "washed, and scrubbed, and shaved, and covered with linen which has been boiled and dried." She would have been given an enema. And chances are she would receive some kind of anesthetic:

> Pain-deadening agents are numerous, harmless, inexpensive and successful; and it is only a matter of experience to find a way of reducing the suffering to an easily bearable if not negligible degree. It may be the "laughing gas" or so-called "twilight sleep", it may be chloroform, ether, or ethylene; but some one of them, or some combination, will be found peculiarly appropriate to each case. It will be both safe and efficient. The necessity is extreme, and it is barbarous to deny a woman this relief.

True to the legacy of Semmelweis, the doctor was advised to wash his hands before examining the labouring women: "The general practitioner, who comes in contact with pus or any other contagious cases, will want to prolong the washing process to fifteen or twenty minutes." In his examination he "notes the location of the [baby's] head and back, finds and counts the heart-tones; and estimates the descent