Panel Comments

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SCMA V — 17 June 2011

Future of *astrostatistics*

$\Updownarrow$

Future of *statistics*

Theme: How the emerging needs of astrostatistics may motivate and benefit from *fundamental* developments in statistics

"Philosophy" and statistics

Chris Genovese (SCMA V)

On the ground in Statistics, the Bayesian-Frequentist debate has mostly faded from view

- Nontrivial philosophical/conceptual differences certainly exist
- There are situations where each approach has an advantage
- Both approaches can be used successfully

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Brad Efron (2010)

"Methodology by itself is an ultimately frustrating exercise. A little statistical philosophy goes a long way but we have had very little in the public forum these days..."

We need more but different struggling with fundamentals & foundations, Bayesian/frequentist & otherwise

Brad Efron (2005)

> The 250-year debate between Bayesians and frequentists is unusual among philosophical arguments in actually having important practical consequences...
>
> Broadly speaking, Bayesian statistics dominated 19th Century statistical practice while the 20th Century was more frequentist. What's going to happen in the 21st Century?...I strongly suspect that statistics is in for a burst of new theory and methodology, and that this burst will feature a combination of Bayesian and frequentist reasoning...

Roderick Little, ASA President's Address (2005)

> Pragmatists might argue that good statisticians can get sensible answers under Bayes or frequentist paradigms; indeed maybe two philosophies are better than one, since they provide more tools for the statistician's toolkit...I am discomforted by this "inferential schizophrenia." Since the Bayesian (B) and frequentist (F) philosophies can differ even on simple problems, at some point decisions seem needed as to which is right. I believe our credibility as statisticians is undermined when we cannot agree on the fundamentals of our subject...

Why so little "philosophy?"

Andrew Gelman (2010)

> "My second meta-principle of statistics is the *methodological attribution problem*, which is that the many useful contributions of a good statistical consultant, or collaborator, will often be attributed to the statistician's methods or philosophy rather than to the artful efforts of the statistician himself or herself. . .
>
> "The result is that each of us tends to come away from a collaboration or consulting experience with the warm feeling that our methods really work, and that they represent how scientists really think. In stating this, I am not trying to espouse some sort of empty pluralism..."

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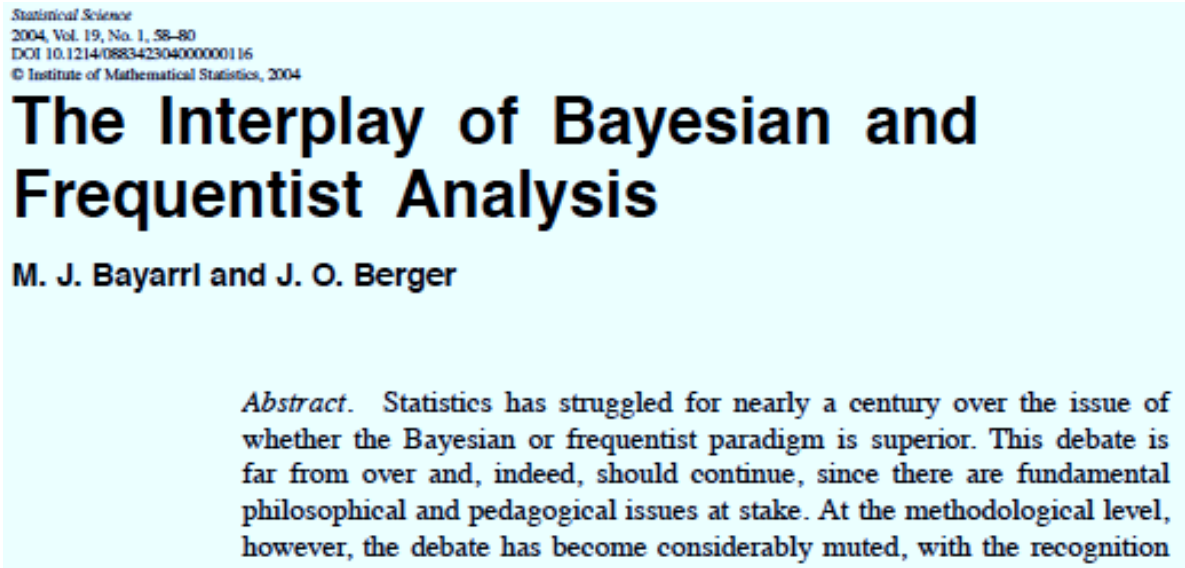
Brilliant analysts can rely on their intution;
the rest of us benefit from *principles* (and collaboration)

Interplay and disagreement



Statistical Science
2004, Vol. 19, No. 1, 58–80
DOI 10.1214/088342304000000116

The Interplay of Bayesian and Frequentist Analysis

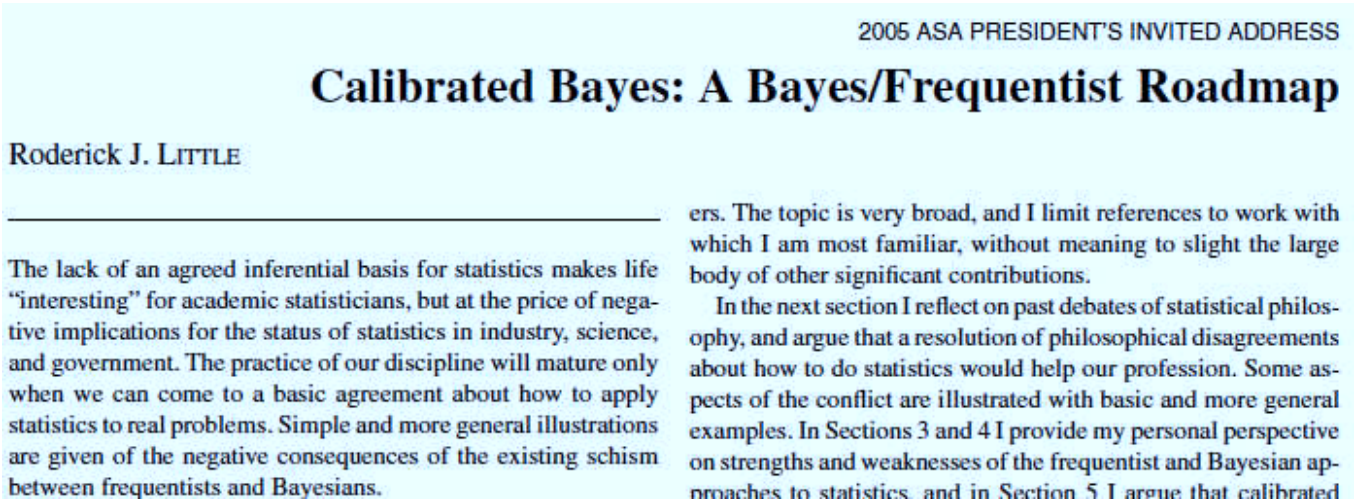
M. J. Bayarri and J. O. Berger

Abstract. Statistics has struggled for nearly a century over the issue of whether the Bayesian or frequentist paradigm is superior. This debate is far from over and, indeed, should continue, since there are fundamental philosophical and pedagogical issues at stake. At the methodological level, however, the debate has become considerably muted, with the recognition

Interplay: Frequentist performance of Bayesian procedures; model checking/assessment; *conditional frequentist testing*

Disagreement: Multiple comparisons, sequential analysis, finite population sampling

Calibrated Bayes?



2005 ASA PRESIDENT'S INVITED ADDRESS

Calibrated Bayes: A Bayes/Frequentist Roadmap

Roderick J. LITTLE

The lack of an agreed inferential basis for statistics makes life "interesting" for academic statisticians, but at the price of negative implications for the status of statistics in industry, science, and government. The practice of our discipline will mature only when we can come to a basic agreement about how to apply statistics to real problems. Simple and more general illustrations are given of the negative consequences of the existing schism between frequentists and Bayesians.

ers. The topic is very broad, and I limit references to work with which I am most familiar, without meaning to slight the large body of other significant contributions.

In the next section I reflect on past debates of statistical philosophy, and argue that a resolution of philosophical disagreements about how to do statistics would help our profession. Some aspects of the conflict are illustrated with basic and more general examples. In Sections 3 and 4 I provide my personal perspective on strengths and weaknesses of the frequentist and Bayesian approaches to statistics, and in Section 5 I argue that calibrated

"An assessment of strengths and weaknesses of the frequentist and Bayes systems of inference suggests that calibrated Bayes. . . captures the strengths of both approaches and provides a roadmap for future advances."

"*Bayesian statistical methods need to be taught.*"

"*More attention is needed to assessments of model fit.*"

Bayes is not a panacea

THE ISBA BULLETIN

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The official bulletin of the International Society for Bayesian Analysis

A MESSAGE FROM THE PRESIDENT

WHAT ARE THE OPEN PROBLEMS IN BAYESIAN STATISTICS?

- Michael I. Jordan -
ISBA President, 2011
jordan@stat.berkeley.edu

que, I am afraid. In particular, the individuals assembled are a highly non-random sample—they are a set of people who have the misfortune of being in the intersection of two sets: (a) highly-respected senior statisticians and (b) entries in my email address book.

The question that I asked was "What do you view as the top two or three open problems in Bayesian statistics?" The focus on Bayes is due

5 Nonparametrics and semiparametrics

4 Priors

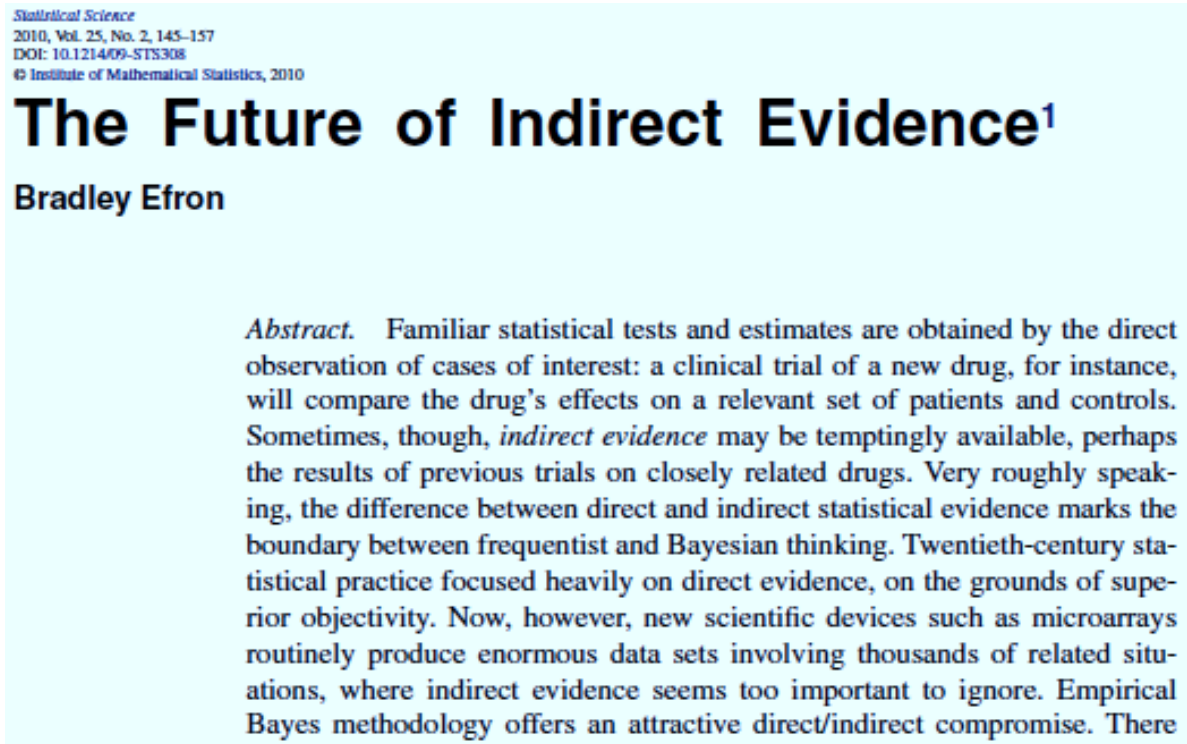
3 Bayesian/frequentist relationships

2 Computation and statistics

1 Model selection and hypothesis testing

Genovese: "Nonparametric and Bayesian methods complement each other"

"Indirect evidence" and the data deluge



Statistical Science
2010, Vol. 25, No. 2, 145–157
DOI: 10.1214/09-STS308

The Future of Indirect Evidence[1]

Bradley Efron

Abstract. Familiar statistical tests and estimates are obtained by the direct observation of cases of interest: a clinical trial of a new drug, for instance, will compare the drug's effects on a relevant set of patients and controls. Sometimes, though, *indirect evidence* may be temptingly available, perhaps the results of previous trials on closely related drugs. Very roughly speaking, the difference between direct and indirect statistical evidence marks the boundary between frequentist and Bayesian thinking. Twentieth-century statistical practice focused heavily on direct evidence, on the grounds of superior objectivity. Now, however, new scientific devices such as microarrays routinely produce enormous data sets involving thousands of related situations, where indirect evidence seems too important to ignore. Empirical Bayes methodology offers an attractive direct/indirect compromise. There

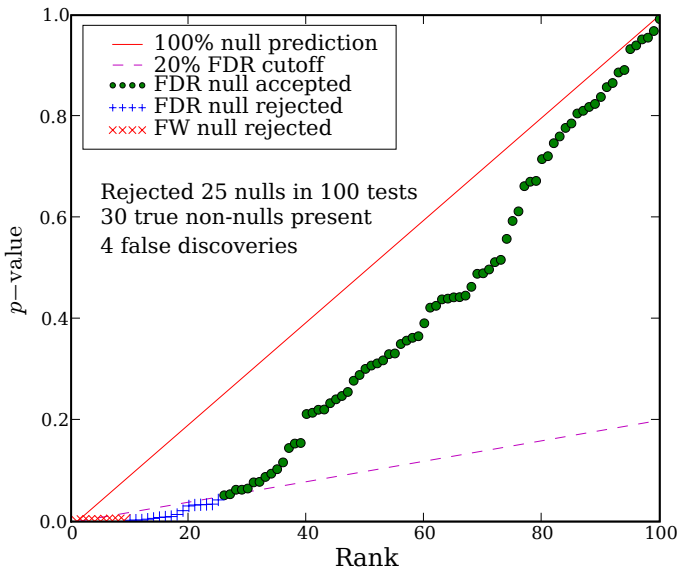
Discussants: Sander Greenland, Andrew Gelman, Robert Kass

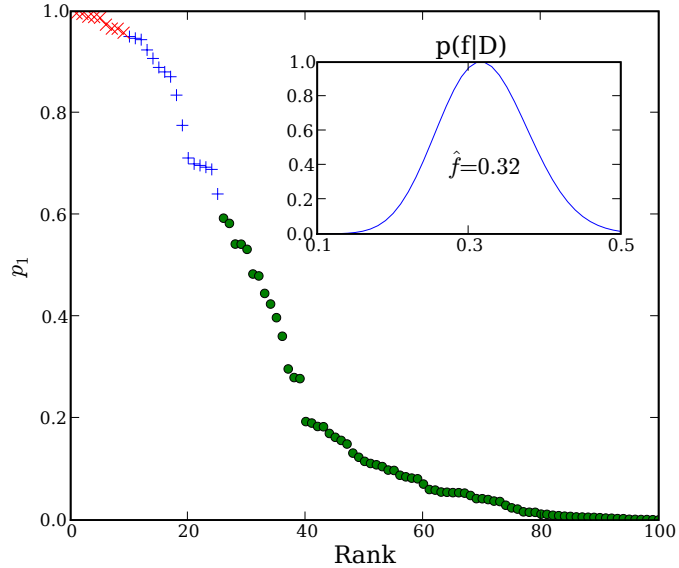
Our "data deluge" may be easily misunderstood.

Big surveys provide many *modest-sized* data sets about objects or events that are related, but in ways that must be discovered from the data.

FDR control: Hammer looking for a nail?

Observe 100 objects, additive noise, 30 sources:





Issue with FDR control: Astronomers will use detections to infer distributions; will be biased for dim sources

Perhaps useful for flagging followup targets

Meinshausen & Rice (2006): Confidence bounds on source fraction

One can say there are about 30 sources present, without being able to say for sure whether many of the candidates are sources or not.

Caution: The "upper level" prior needs some care in more complex settings (Scott & Berger 2008; MLM literature)

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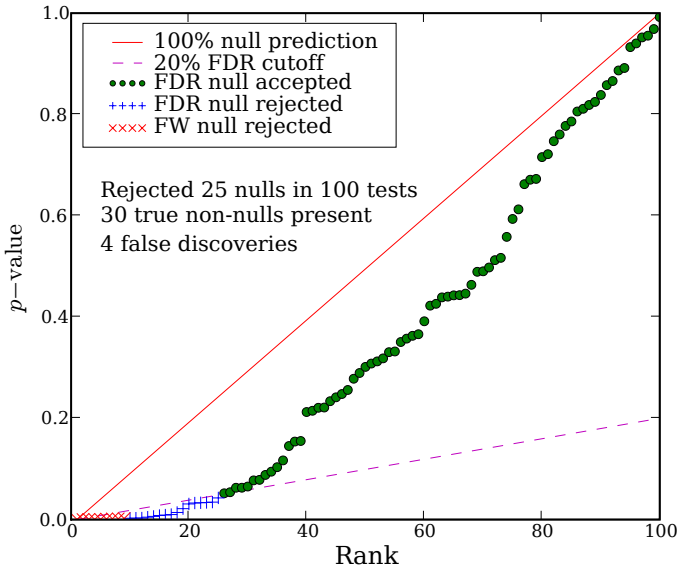

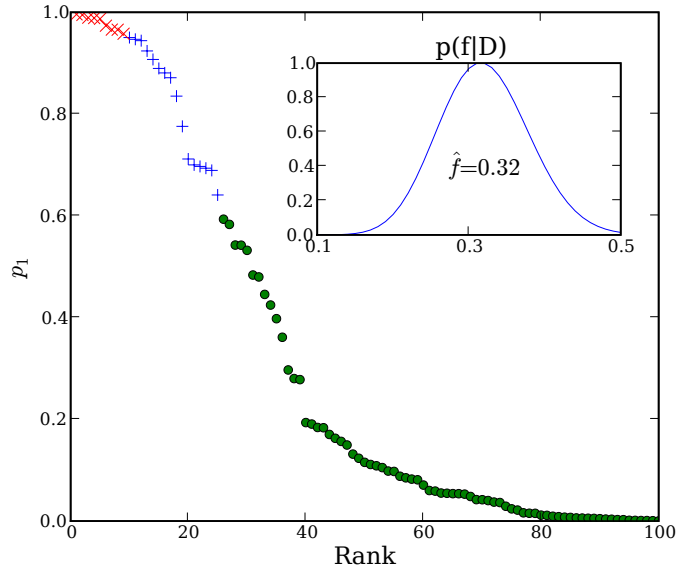

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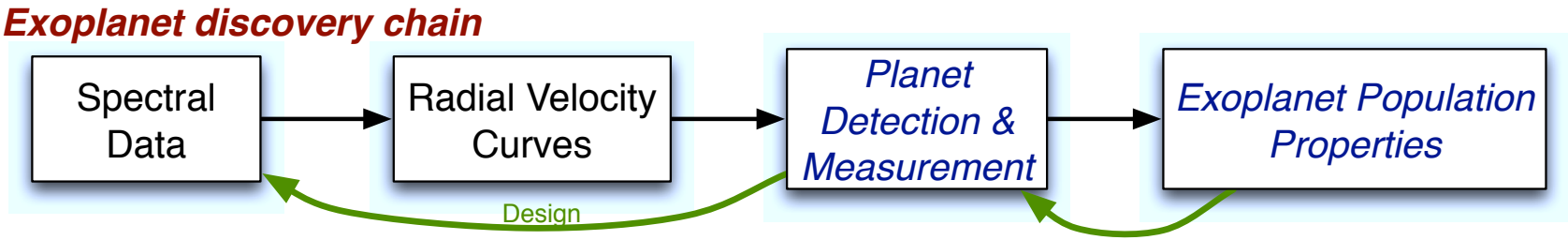
Gelman (2010): "To me, the false discovery rate is the latest flavor-of- the-month attempt to make the Bayesian omelette without breaking the eggs. . . "

How can we robustly move away from hard thresholds?

Final Provocation

Thesis: Important data analyses are often used sequentially

- Sequential experimentation/exploration
- Chains of discovery (individual $\rightarrow$ population)



Herman Chernoff on sequential analysis (1996):

> *I became interested in the notion of experimental design in a much broader context, namely: what's the nature of scientic inference and how do people do science? The thought was not all that unique that it is a sequential procedure. . .*
>
> *Although I regard myself as non-Bayesian, I feel in sequential problems it is rather dangerous to play around with non-Bayesian procedures.... Optimality is, of course, implicit in the Bayesian approach.*