

ANA TIMBERLAKE LECTURE
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STATISTICAL INFERENCE: HISTORY, PRESENT POSITION AND
FUTURE
D.R.Cox
Nuffield College, Oxford

History

Stigler's law of eponymy

Application of probabilistic ideas to the analysis and interpretation of data
Very restricted topic

R.A.Fisher and Harold Jeffreys

Neyman and E.S.Pearson

Principles of inference
Not foundations
Conceptual not intrinsically mathematical
Interplay with subject-matter crucial

Nature of probability
Kolmogorov's axioms
Limited suggestions for extension

Two main meanings (with many variants)
Representation of 'physical' variation
Representation of uncertainty

Jeffreys(1939) called the former *chances*.

Critical nature of model choice

Types of model

Meaning of probability in the definition of a model

First view of probability represents

- long-run proportions in a repetitive process, possibly directly linked to subject-matter theory
- proportions in a hypothetical population
- process of physical randomization in experimental design or sampling

Second view of probability represents

- direct adaptation of hypothetical frequency ideas via notions of calibration
- some relatively objective view of degree of belief (Laplace, Keynes, Jeffreys)
- personalistic degree of belief (F.P. Ramsey, de Finetti, L.J.Savage)

- $(1 - \epsilon)$ confidence limit
- nested set of such limits
- confidence distribution
- Bayesian posterior distribution with 'flat prior'
- may be exactly or nearly the same numerically but are they the same conceptually?
- difficulties of complete resolution

Frequentist approaches do *not* ignore prior information

Two versions of Bayes theorem

$$P^*(H | D) \propto P^*(D | H)P(H)$$

$$P(H | D) \propto P(D | H)P^*(H)$$

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Implications

- temporal coherency
- prospective versus retrospective explanation
- how is consistency of prior and data to be tested?
- consequences for planning

Significance tests
Test of hypotheses
Bayesian hypothesis testing

A summary view

Contrast is not Bayesian versus frequentist but

- What can be learned from specific data (combined with assumptions)?
- How can those assumptions be tested and better formulations found?

with

- How should 'You' act in the light of these data and other considerations?

Tactics and strategy