Reactions from a Frequentist

Eric Slud, MATH Dept., UMCP

Berger talk

- Aren't there practical limits to 'objective' priors ?
  e.g., dependent parameters, non-nested models
- Large complex structures: frequentist MCMC-envy
- When should 'objective' become 'empirical' ?

Rao talk

- Historically survey methods have avoided model-based analyses – Bayesian or frequentist !
- Small-area estimation & nonresponse make models unavoidable: *how should the models be judged ?*
- High-dimensional parameters: how to choose priors
  matching, multinomial parameters, many approaches

A Survey Challenge for Bayes Methods

Multiple Overlapping-Frame Surveys

eg problems where the joint info of Admin Records and a Large Survey must be modelled

Medical Diagnosis Example

Structure: simple ML estimators $\hat{p}_i$ available

$$\vartheta = g(p_0, p_1, p_2) \qquad \textbf{nonlinear}$$

Sample sizes modest, Δ method not promising

Frequentist approaches: might use parametric or nonparametric bootstrap

or Profile Likelihood-based test-based CI for ϑ

The Bayes approach seems to work well here: but how could one know that apart from the simulation for particular (p_0, p_1, p_2) combinations ?

Simulation or bootstrap might provide moderate-sample frequentist distribution theory for LR test ...

Large Hierarchical Models

Berger: Pyroclastic-flow example

Rao: Hierarchical survey models in small-area estimation

Frequentists can envy the MCMC calculating machine

but

a lot of problem knowledge goes into finding reasonable parameter ranges: 'objective' priors might not be feasible

marginal treatment and independence of (scalar) parameter may not be reasonable

These problems offer a very different route to Bayesian analysis : not so objective, but maybe the only route to quick answers !

Well suited to exploration: but it may be very hard to discriminate or validate models.

How to justify such models to frequentists in large surveys & problems of public policy ?

Model Selection & Search

Berger example with model selection has features

(a) nesting within a fixed comprehensive model

(b) (within the Breiman-Freedman ozone application) **no small set of models gets strong posterior weight**

In this setting, the Example shows some of the most attractive features of Bayes methods:

- effective calculation of posterior distributions of all model-related quantities
- creative use of posterior conditional probabilities to answer a model-building question (posterior frequency with which models contain a specified component), and
- no natural frequentist solution.

How do we avoid the necessity to simulate within a statistically valid model for the MCMC & Bayes theory to apply ?

Jeffreys & Matching Priors

PRIOR CHOICE IS THE CRUX OF THE FREQUENTISTS' DIFFICULTY

Jeffreys prior gives one [not the only] parameter-coordinate-free approach to choosing a prior

relies on fixed model specification:

would we use this idea if we specified parametric model M_j *holds with probability* π_j *for several* j *?*

would one use these objective priors in a high-dimensional hierarchical setting ? I haven't seen this being done.

Matching priors: for problems like the Fay-Herriot where they are available, seem to provide flexible Bayesian estimates in a setting where frequentist methods are also adequate.

HOW BROADLY CAN THESE METHODS BE APPLIED ?

Misspecified Models

seem to me a particular weakness of Bayesian and many frequentist analyses:

THEORY & MACHINERY REQUIRE VALID MODELS.

Frequentists (sometimes) try to go beyond this difficulty by approaches involving

- Semiparametric methods
- Estimating Equations
- Permutational/bootstrap methods (to assess performance of misspecified model estimates.)

Bayesians have

- Dirichlet process priors for semiparametrics.
- Model averaging approaches.

FOR ME, THE NEED TO HANDLE MODEL MISSPECIFICATION IS A CONTINUING OBSTACLE TO COMFORT WITH BAYESIAN APPROACHES.