A Bayesian approach to stochastic cost-effectiveness analysis

Andrew H. Briggs

Health Economics Research Centre
Oxford Institute of Health Sciences
New treatment more costly
New treatment more effective
New treatment less effective
New treatment less costly

Old treatment dominates
New treatment dominates
Maximum acceptable ICER
Incremental cost-effectiveness ratios

\[ ICER = \frac{\Delta C}{\Delta E} > R_c \]

\[ \text{var}(ICER) = ??? \]

**Confidence intervals:**
Fieller’s theorem: assumes joint normality
Bootstrapping: makes no distributional assumption
The net-benefits approach

\[ N\hat{B}_C = R_c \Delta \overline{E} - \Delta \overline{C} > 0 \]

\[ \text{var}(N\hat{B}_C) = R_c^2 \text{var}(\Delta \overline{E}) + \text{var}(\Delta \overline{C}) - 2R_c \text{cov}(\Delta \overline{E}, \Delta \overline{C}) \]

\[ \left( N\hat{B} - z_\beta \sqrt{\sigma^2_{NB}}, \quad NB + z_\beta \sqrt{\sigma^2_{NB}} \right) \]
Probability cost-effective vs. Value of ceiling ratio (£ sterling)

- **Prior distribution**
- **Posterior distribution**
- **Posterior (uninformative prior)**
Cost-effectiveness analysis of improved blood pressure control in hypertensive patients with type 2 diabetes: UKPDS 40

1,148 hypertensive type 2 diabetic patients

390 less tight control
BP ≤ 200/105 mmHg
(BP < 180/105 mm Hg)

758 tight control
BP < 150/85 mm Hg
Probability that intervention is cost-effective

Ceiling value for incremental cost-effectiveness ratio

- Costs 6%, effects 0%
- Costs 3%, effects 3%
- Costs 6%, effects 6%

4S: cholesterol lowering, 59 year old male with CHD
UK breast cancer screening programme (Forrest Report)
Oxcheck: cardiovascular lifestyle advice, 50 year old male
The authors of the original cost-effectiveness analysis noted that although cost-effectiveness of antihypertensive programmes based on education and drugs have been reported for a number of populations

"...these analyses have mainly been based on models and lack information on effectiveness and use of resources from long term trials, and none has considered hypertensive patients with type II diabetes."
CEA of the Swedish Trial in Old Patients (STOP) Hypertension trial

• Reported CE ratios for elderly patients of SEK 70,000/LYG for men and SEK 80,000/LYG for women (health care perspective)

• Translating these results into 1996 UK pounds gives a rough CE ratio of £9,000/LYG across men and women based on incremental cost of £1,400 and 0.16 gain in life year per hypertensive patient

• Standard errors for these figures were estimated from information given in the economic evaluation and the original clinical trial report
A Bayesian approach to stochastic CEA: discussion and future research

- Bayesian methods give ‘what the researcher wants’ prob(Hypothesis | Data)
- Through the use of net-benefits CEA curves frequentist/Bayesian methods with uninformative priors shown to be equivalent?
- Empirical Bayes methods uncontroversial? Equivalent to simply ‘pooling’ data in a meta analysis
- No mention of subjective priors? Do they have a role in public policy research?
- No discussion of the loss function?