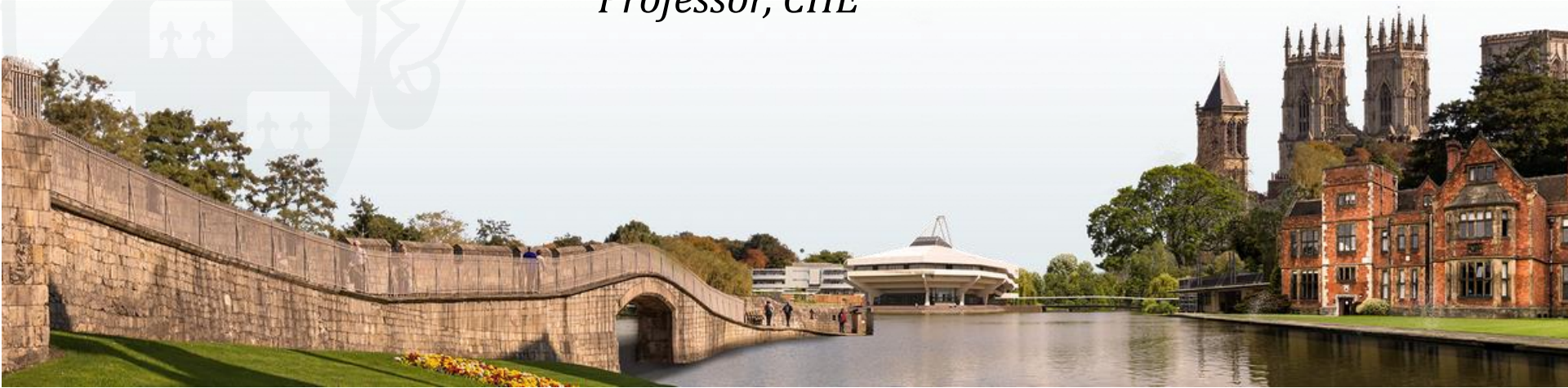**Online Advanced Methods for Cost-Effectiveness Analysis**

Presentation 7: Uncertainty, heterogeneity and VOI
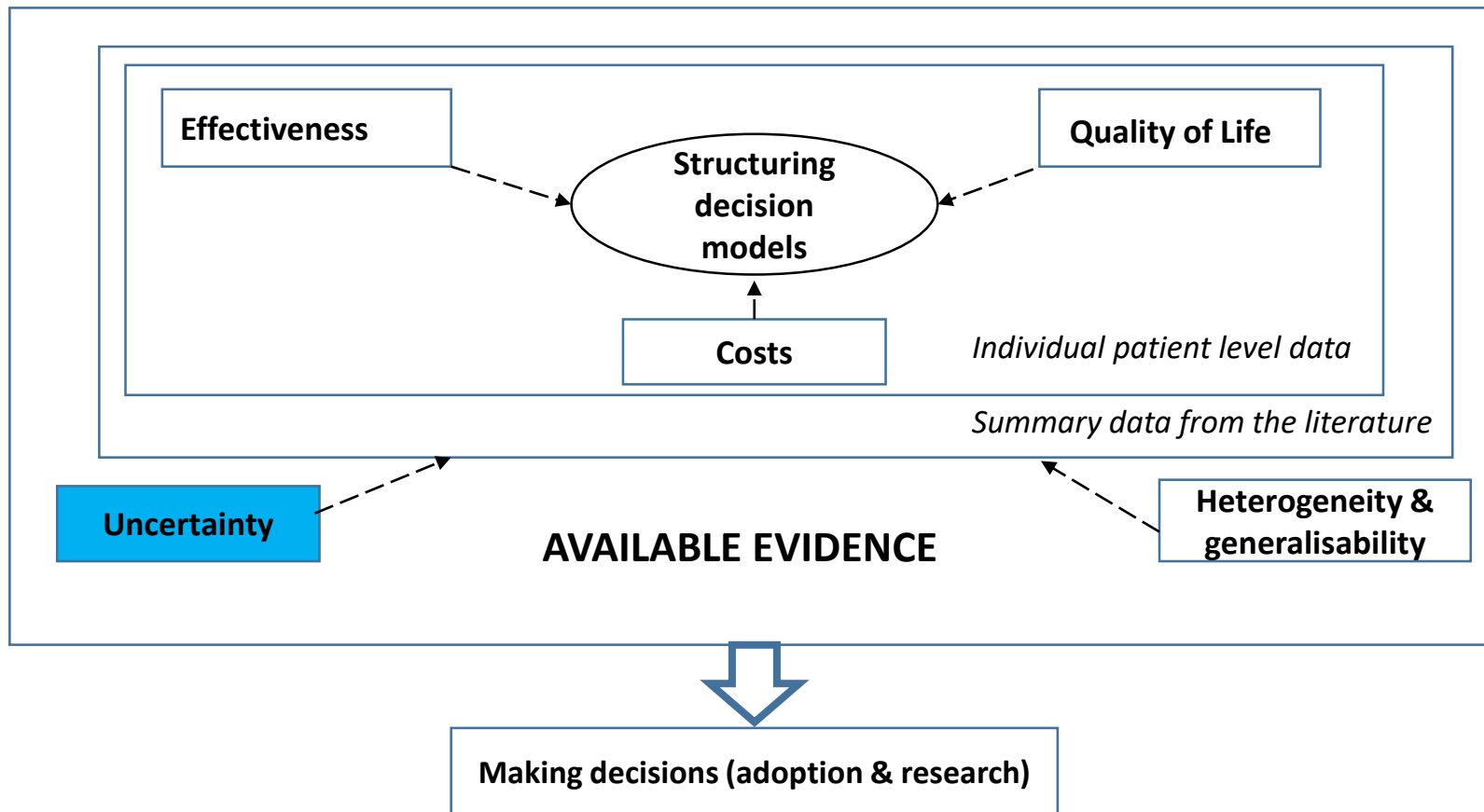**7.3: Reporting uncertainty in results**
Susan Griffin, PhD
Professor, CHE

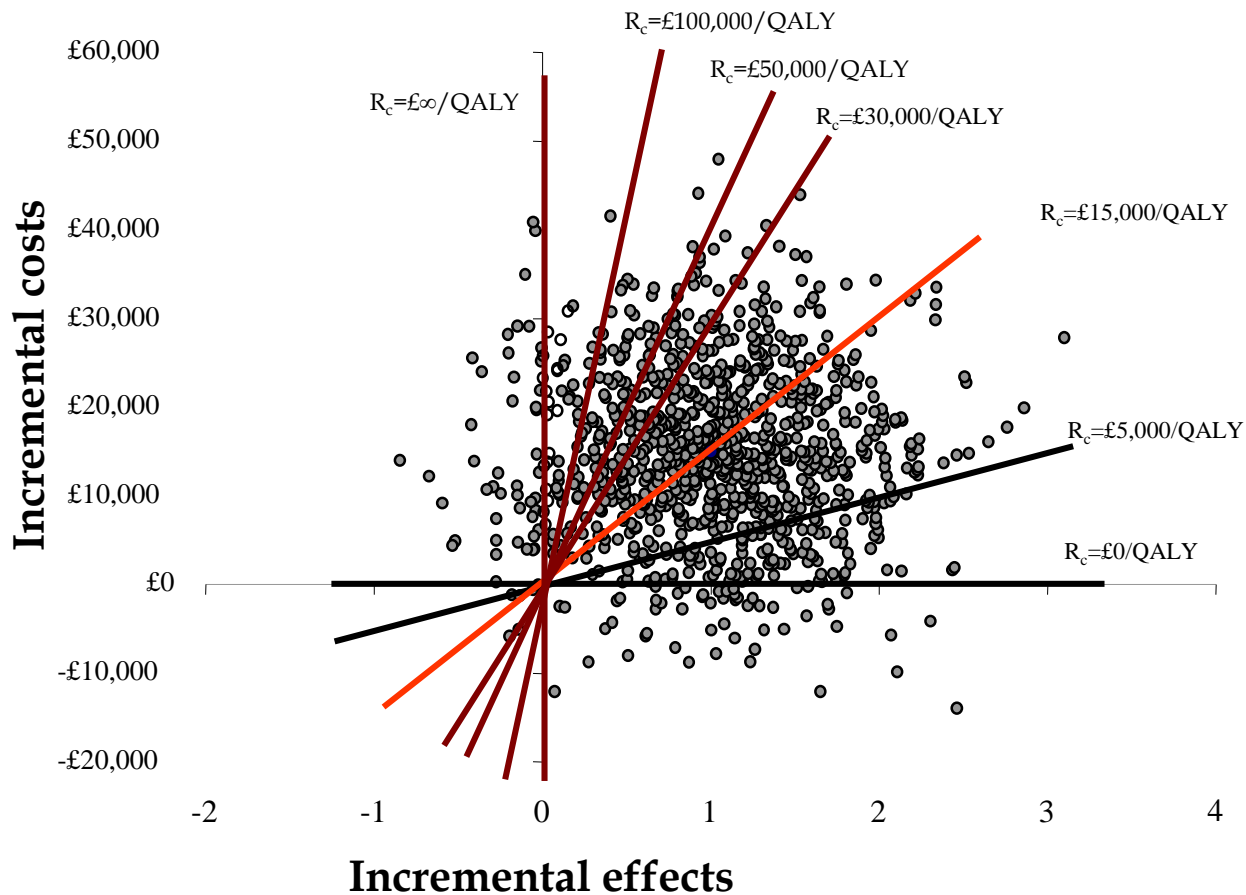# Course structure – where are we up to?

Objectives

- Understand how to interpret the uncertainty captured with probabilistic sensitivity analysis

- Appreciate the limitations of the ICER, and the utility of net benefit statistics

- Understand common methods of display
  - Cost effectiveness planes
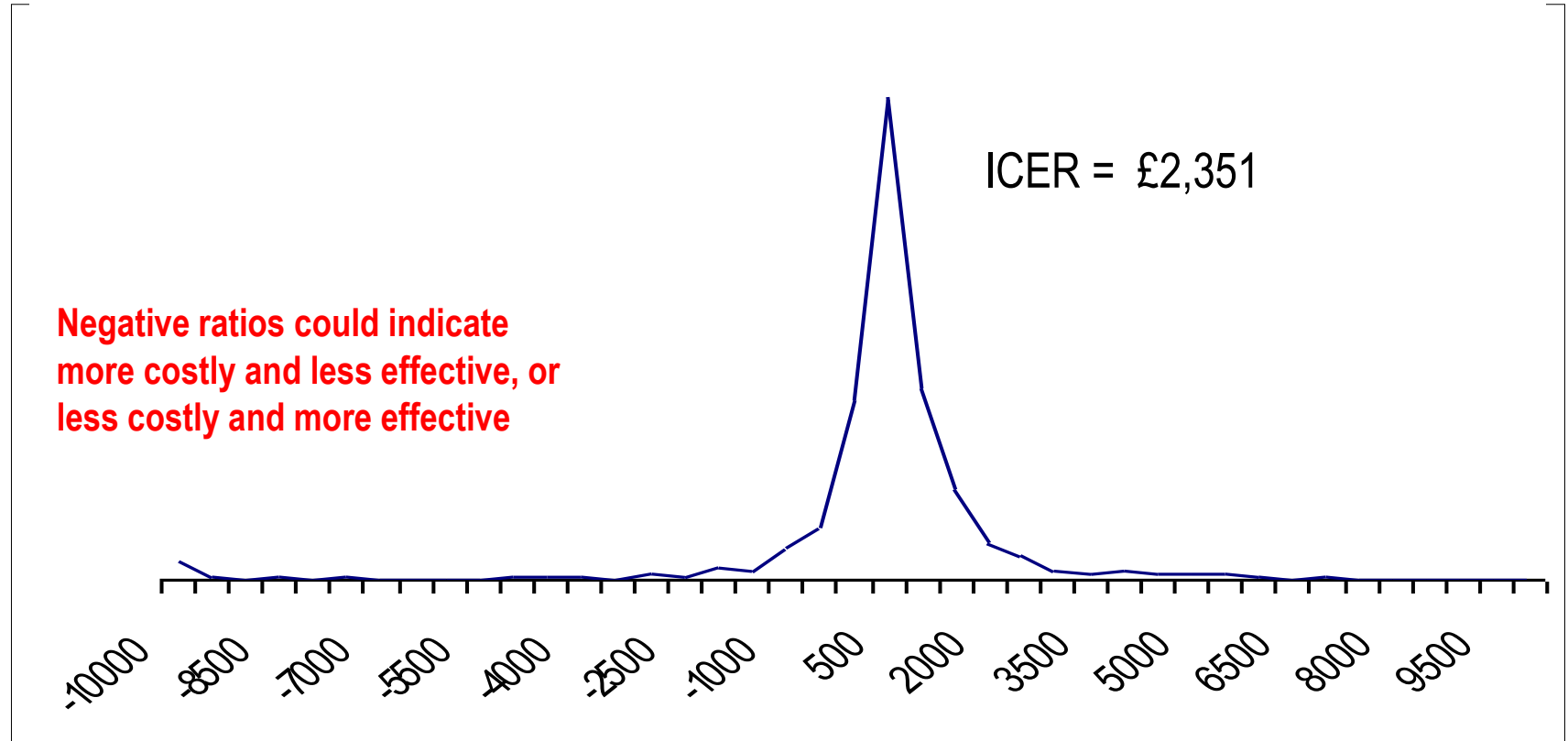 - Cost effectiveness acceptability curves and frontiers

Reporting results

- Distribution of outcomes for each strategy
  - Cost-effectiveness plane informed by output of Monte Carlo simulation

- Confidence intervals for the expected outcome
  - Problems with ICER as ratio statistic
  - Can be used for incremental net benefit
  - Focus on pair-wise comparisons

- Probability that a particular intervention is optimal
  - Cost-effectiveness acceptability curve
  - Cost-effectiveness acceptability frontier

Cost-effectiveness plane

Distribution of ICER

ICER = £2,351

Negative ratios could indicate more costly and less effective, or less costly and more effective

-10000   -8500   -7000   -5500   -4000   -2500   -1000   500   2000   3500   5000   6500   8000   9500

Net Benefit Framework

- Reformulate the traditional decisional rule in terms of
  - Incremental Net Benefit = $(\Delta Q)\lambda - (\Delta C) > 0$
  - Net Benefit = Max $(Q_i.\lambda - C_i)$

- Easy to calculate and avoids problems with ICER

  - Negative INB has one interpretation

  - Maximising NB simplifies multiple treatment comparisons

- NB is function of the unknown value λ

  - Not necessarily a weakness of this approach

  - Forced to explicitly consider the value λ

CEACs: Multiple treatment options

- Standard acceptability curve has a complement that represents the comparator alternative

- In the multiple option case, only one treatment can be cost-effective given a particular cost-effectiveness threshold and in any one simulation

- For each option and for each simulation formulate an indicator of whether that option is optimal

- Average across all simulations to find the proportion of times each option is optimal for a given threshold

- Repeat process varying the threshold and plot the results

# How uncertain is a decision?

- Calculate net benefit for λ=£30,000

Simulation	Treat X	Treat Y	Treat Z	Optimal choice
Simulation 1	11	12	13	Z
Simulation 2	12	10	9	X
Simulation 3	13	18	15	Y
Simulation 4	14	16	17	Z
Simulation 5	15	14	11	X
Expectation	13	**14**	13	

- Probability X is cost-effective = 40%
- Probability Y is cost-effective = 20%
- Probability Z is cost-effective = 40%

Choose Y and expect 14 QALYs
But we are not always right
Probability of error = 0.8
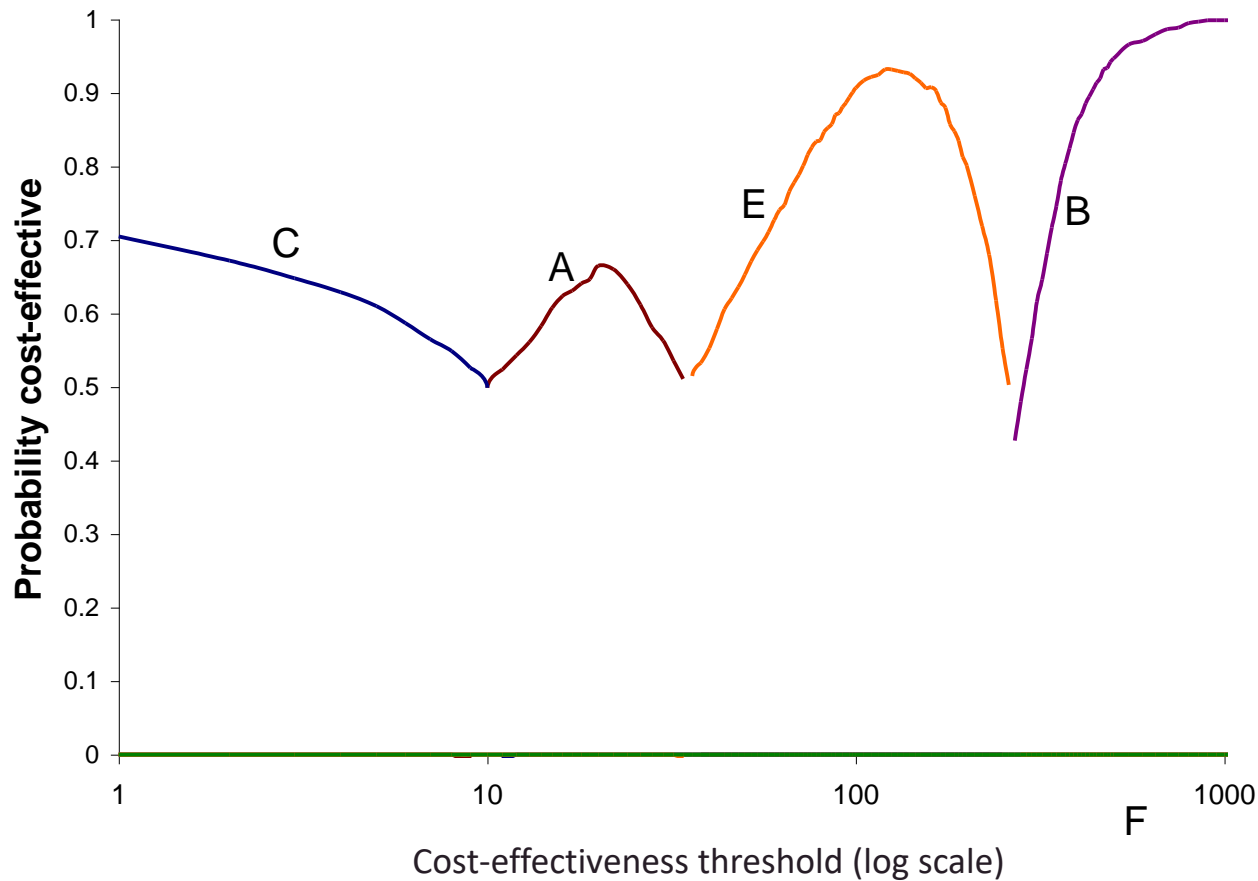
Cost-effectiveness acceptability curve (CEAC)

- Illustrates the uncertainty around the estimate of cost-effectiveness
- Shows the probability that one treatment is cost-effective relative to the alternative treatments for a range of threshold values
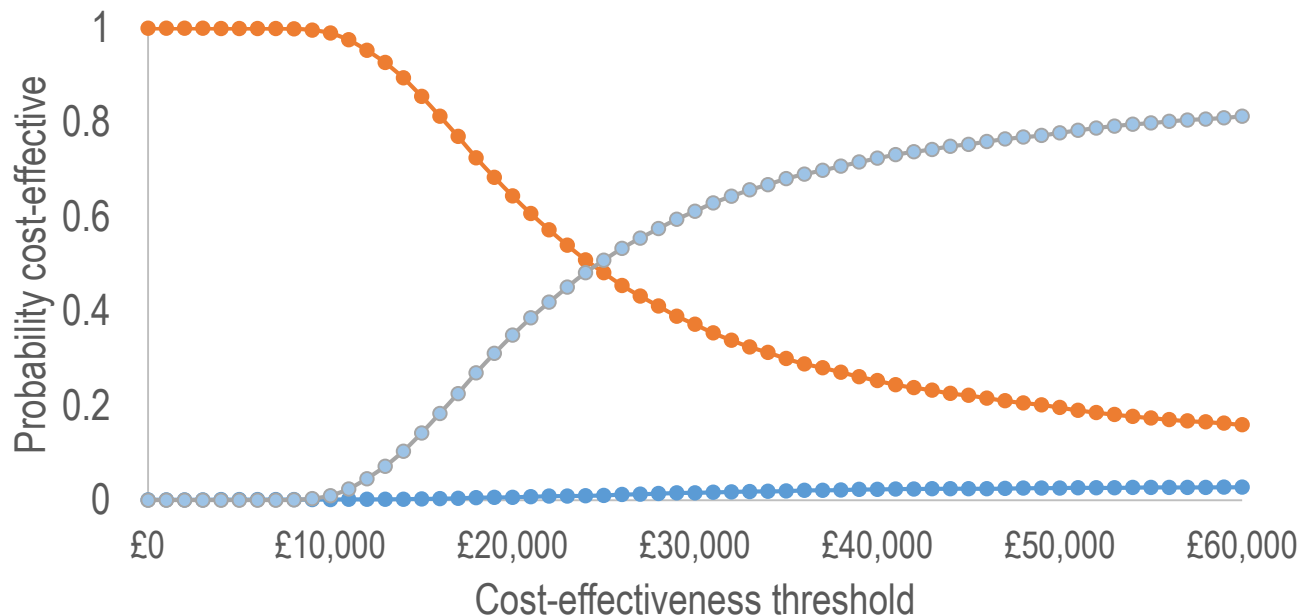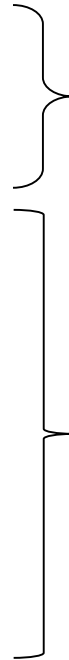
Multiple CEACs: GERD management example
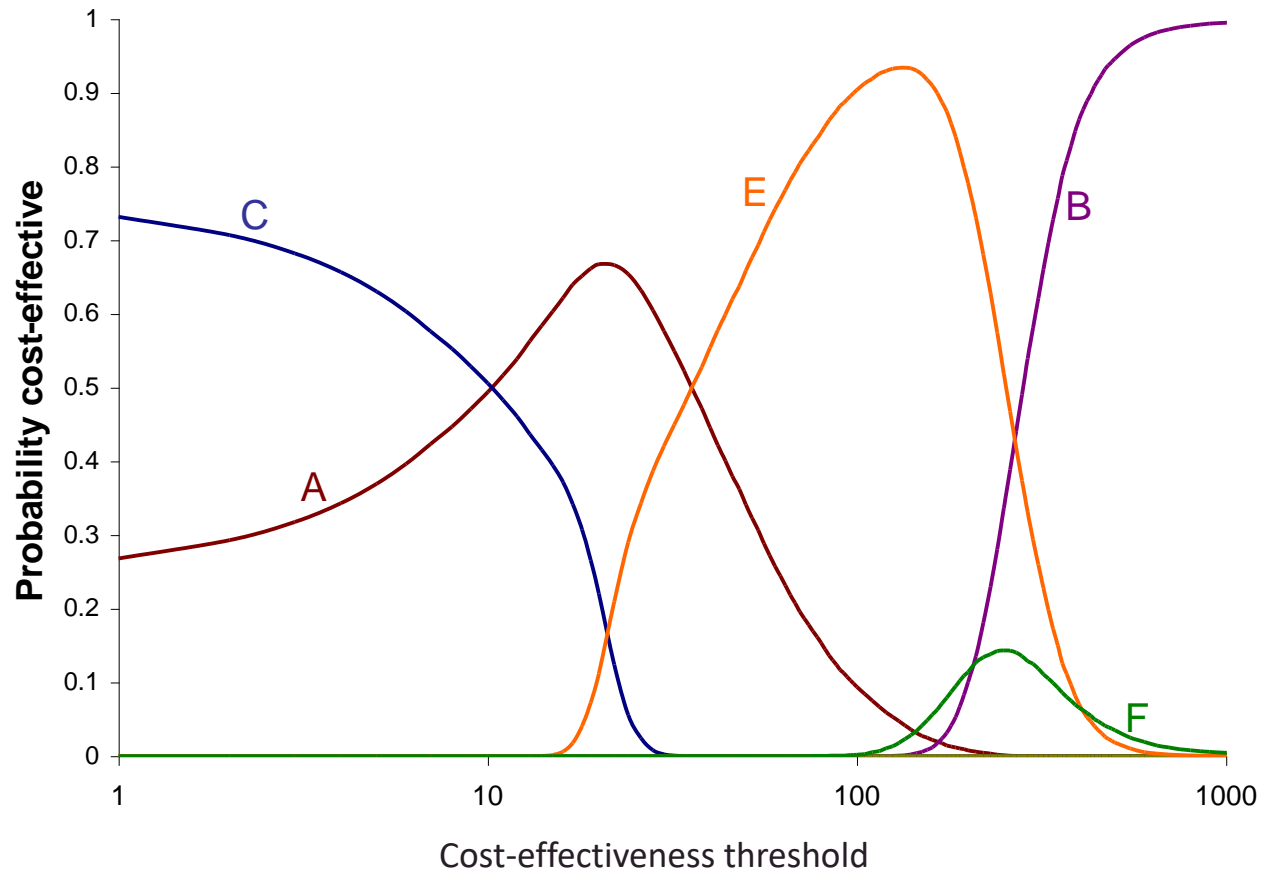
Cost-effectiveness acceptability frontier (CEAF)

Summary

- Heterogeneity
- Structural uncertainty   scenario/deterministic SA
- Policy choices
- Parameter uncertainty
- Distributions
  - fitted
  - assigned   probabilistic SA
  - elicited
- Outcomes summarised
  - cost-effectiveness plane
  - CEAC, CEAF

Reading list

- Briggs AH. Handling uncertainty in cost-effectiveness models. *PharmacoEconomics* 2000; 17(5): 479-500.

- Briggs AH, Goeree R, Blackhouse G, O'Brien BJ. Probabilistic analysis of cost-effectiveness models: choosing between treatment strategies for gastroesophageal reflux disease. *Medical Decision Making* 2002; 22: 290-308.

- Briggs A, Claxton K, Sculpher MJ. *Decision modelling for health economic evaluation*. Oxford University Press, 2006.

- Claxton K. Characterising, reporting, and interpreting uncertainty. In: Drummond, Sculpher, Claxton, Stoddart and Torrance *eds. Methods for the Economic Evaluation of Health Care Programmes.* Oxford, UK. Oxford University Press, 2015.

- Fenwick E, O'Brien B, Briggs AH. Cost-effectiveness acceptability curves – facts, fallacies and frequently asked questions. *Health Economics* 2004; 13: 405-415.

- van der Bles AM, van der Linden S, Freeman ALJ, et al. Communicating uncertainty about facts, numbers and science. Royal Society Open Science 2019;6: 181870