

What is the balance between certainty and uncertainty?

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Overview

- Decision analysis
 - Objective function
 - The decision to invest/disinvest in health care programmes
 - The decision to require further evidence
- Characterising uncertainty
 - Epistemic uncertainty, quality of evidence, modelling uncertainty
- Possibility for research

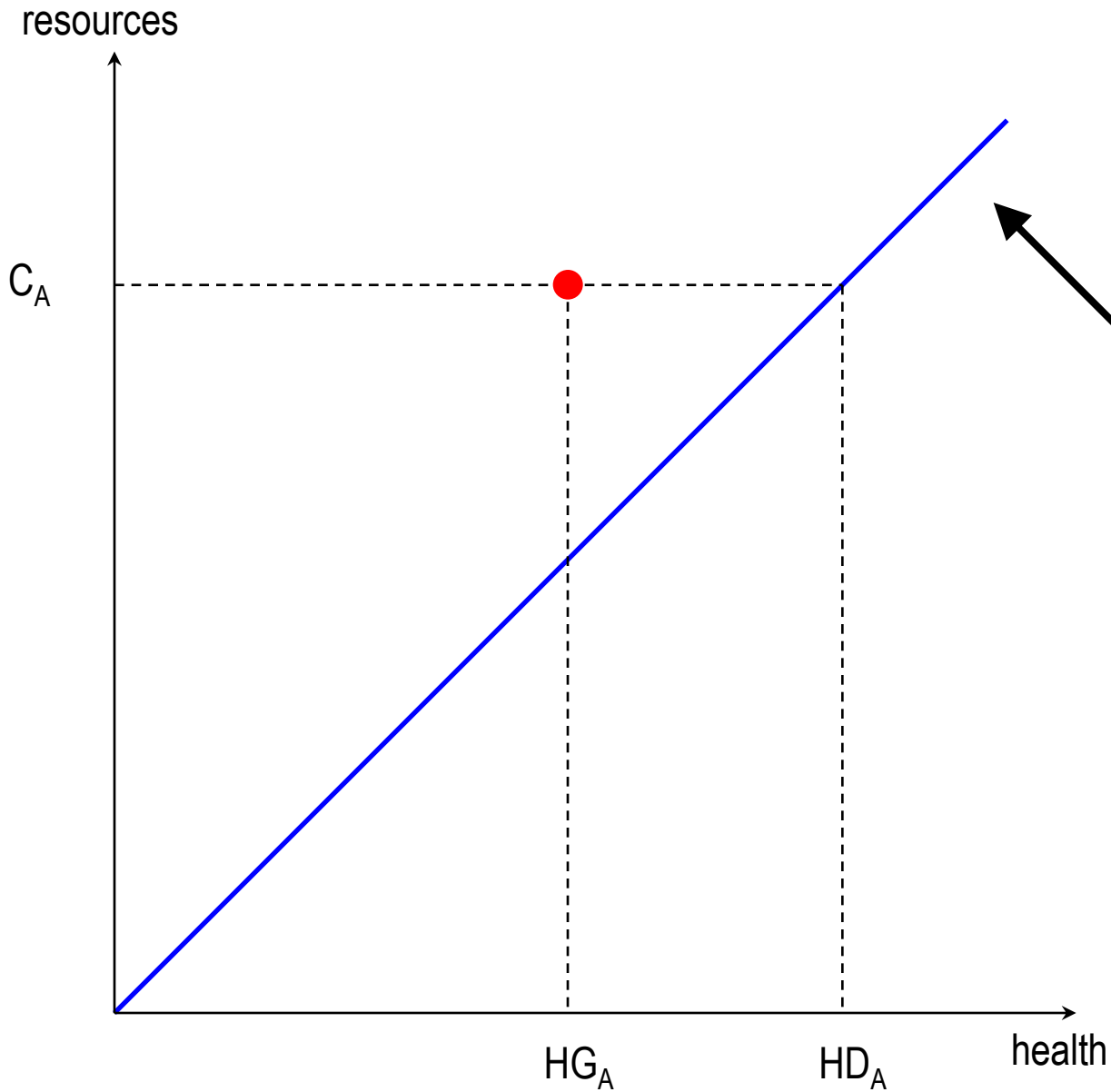
Theory

Objective function

- Methods can be applied to any decision problem
 - Objective
 - Quantitative index measure of outcome
- Maximise health subject to budget constraint
 - Value improvement in quality of life in terms of equivalent improvement in length of life → QALYs
- Maximise health and equity s.t budget constraint
 - Value improvement in equity in terms of equivalent improvement in health

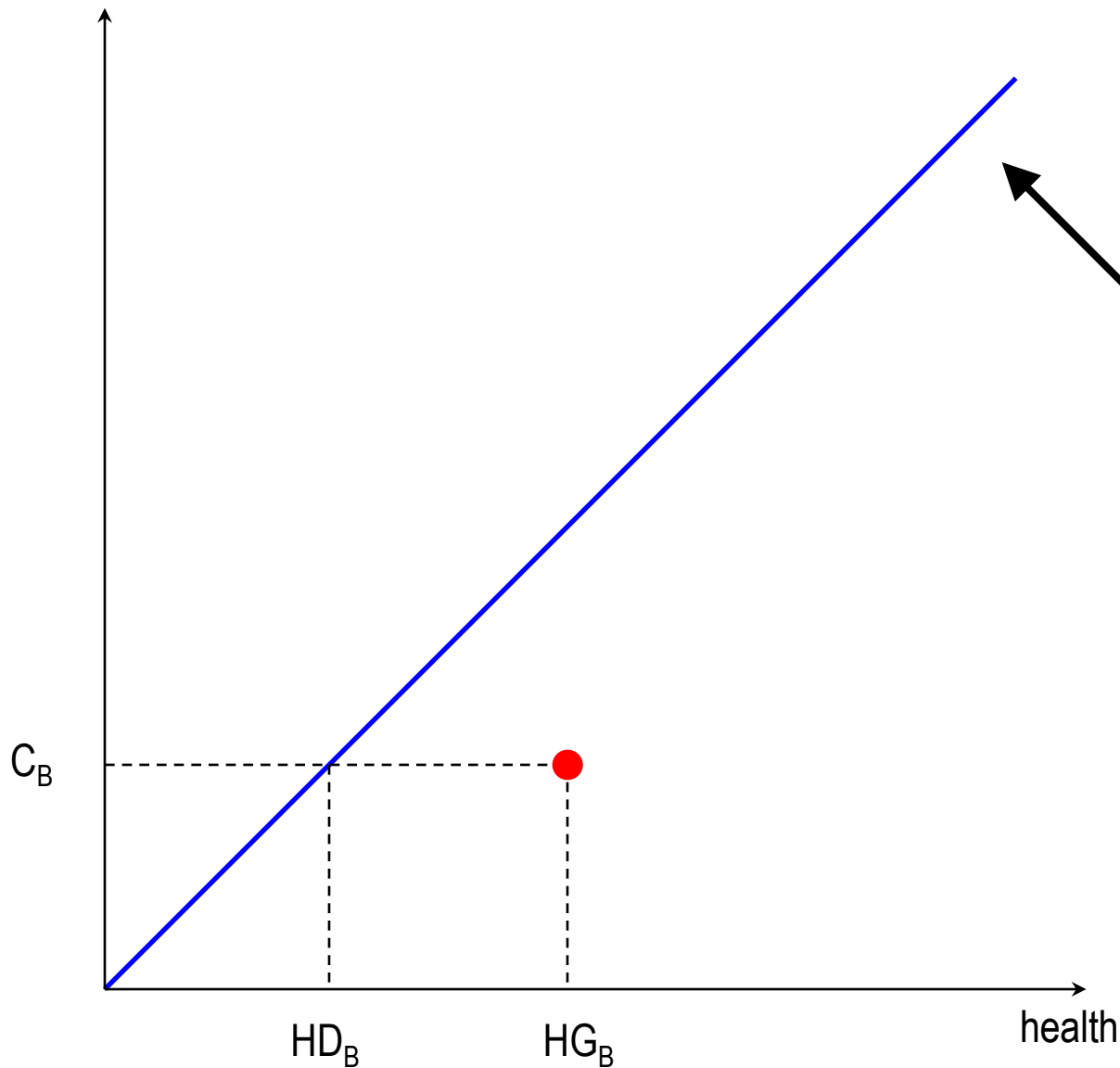
The decision to invest

- Maximise health subject to budget constraint
 - Constrained optimisation problem
 - Given costs and health outcomes of all available programmes, identify optimal set
- Marginal approach
 - Introducing new programme displaces existing activities
 - Compare health gained to health forgone



Slope gives rate at which resources converted to health gains with currently funded programmes

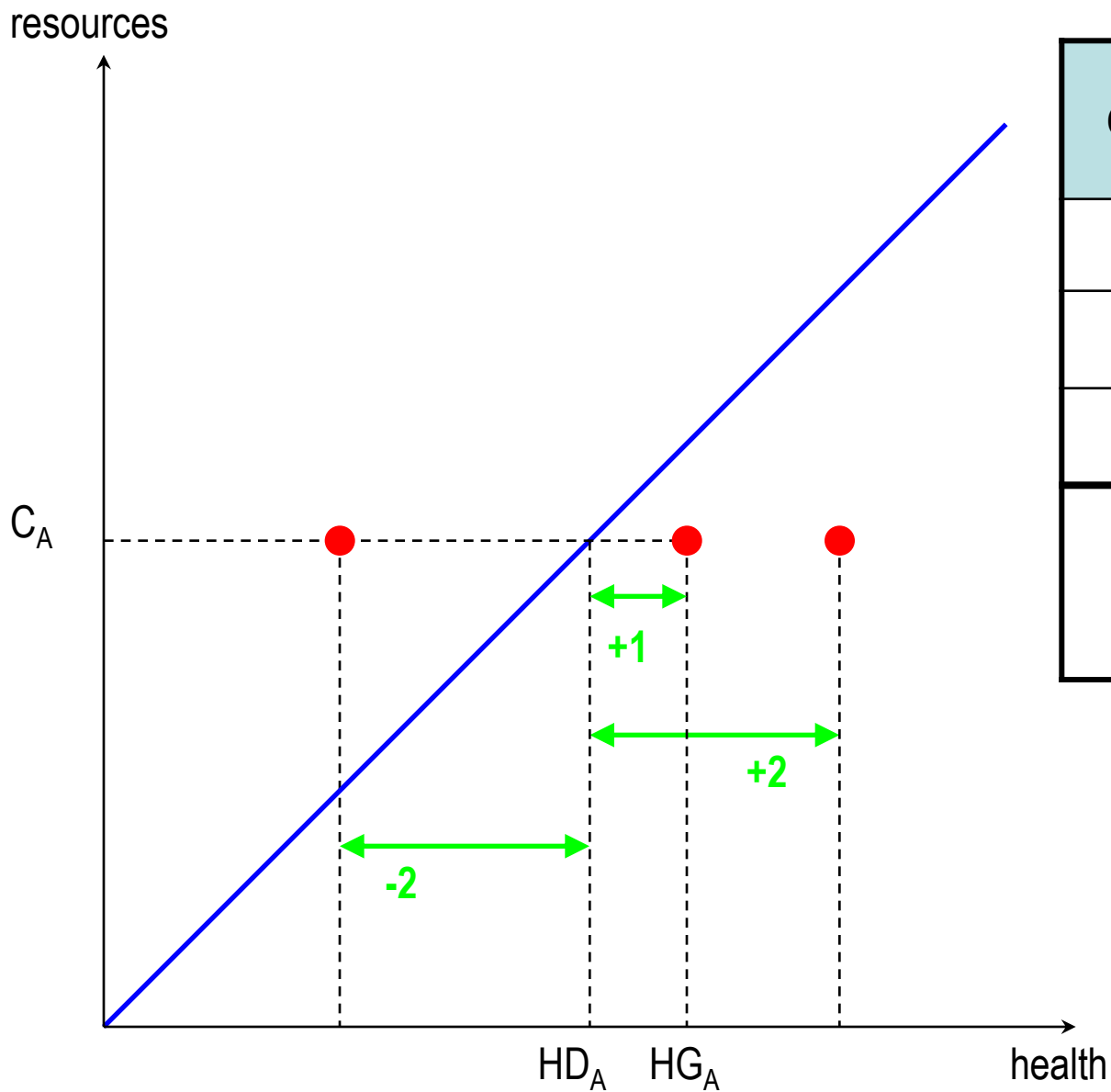
resources



Slope gives rate at which resources converted to health gains with currently funded programmes

Requiring more evidence

- Costs and health outcomes estimated with uncertainty
- Cost of uncertainty: programme funded on basis of estimated costs and outcomes might turn out not to be that which maximises health gains
 - Likelihood of wrong decision
 - I.e. probability that programme selected did not maximise health
 - Consequences of wrong decision
 - Amount of health forgone



Choose	Uncertain	Not uncertain
	+1	
	+2	
	-2	
A	0.33	

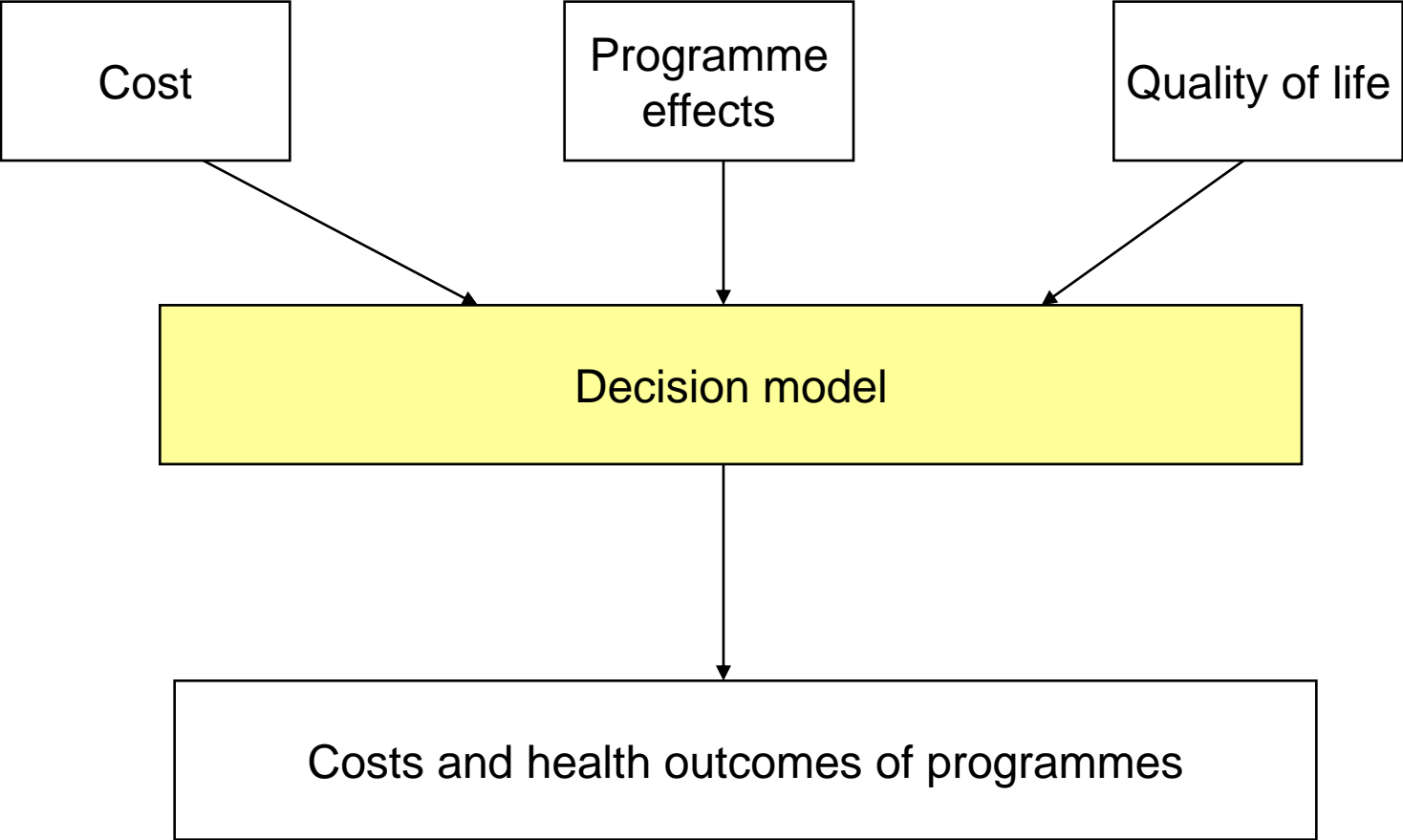
Value of information

- Additional information has value
 - Allows avoidance of wrong decision and associated health losses
 - Better decisions → better health gains
- Compare cost of uncertainty to cost of obtaining additional evidence
 - Gather additional evidence if cost of uncertainty $>$ cost of research
 - If cost of uncertainty $<$ cost of research then may conclude current evidence is sufficient

Putting theory into practice

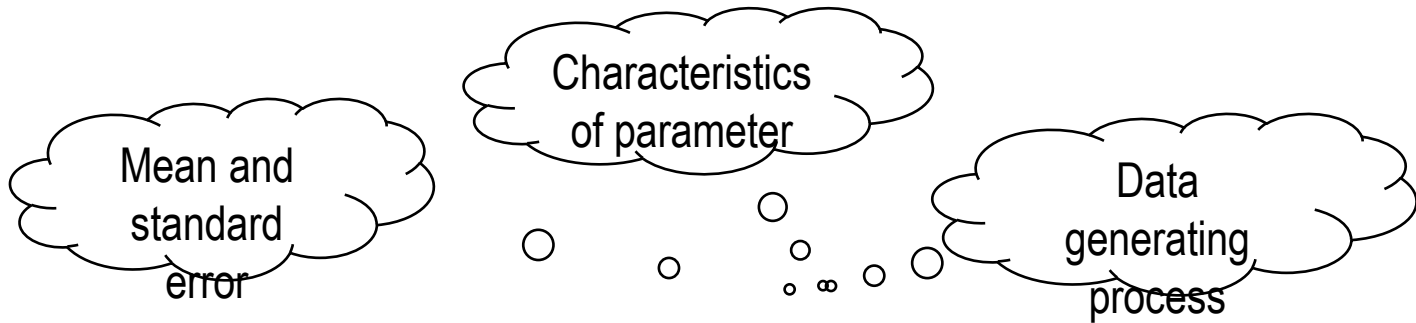
Estimating costs and effects

- Gather available evidence on costs and health outcomes
 - Rare to have single source of evidence that provides all required
- Use decision-analytic model to combine evidence from a range of sources
 - Synthesise data from multiple trials, e.g. meta-analysis
 - Extrapolate to relevant time horizon, e.g. survival analysis
 - Estimate overall costs and health outcomes, e.g. Markov model

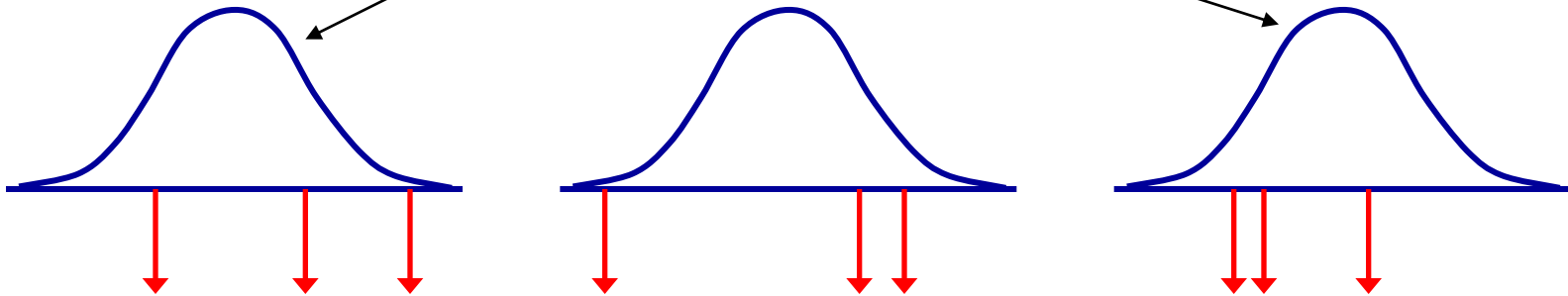


Characterising uncertainty I

- Epistemic uncertainty
 - Uncertainty related to incomplete or inadequate information
- If information is incomplete, exists a range of plausible values for each parameter
- Specify range of values to use in decision model
 - Sampling error → standard error, confidence interval
 - Lack of data → elicit expert opinion

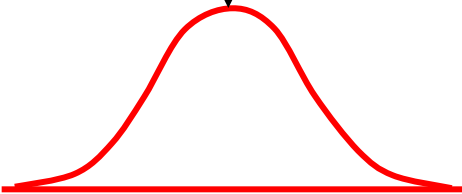


Assign distribution



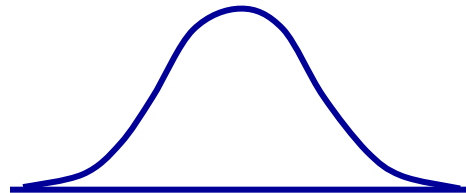
Repeatedly take randoms draws from assigned distributions and calculate expected costs and outcomes for each

Generate distribution of expected costs and outcomes



Characterising uncertainty II

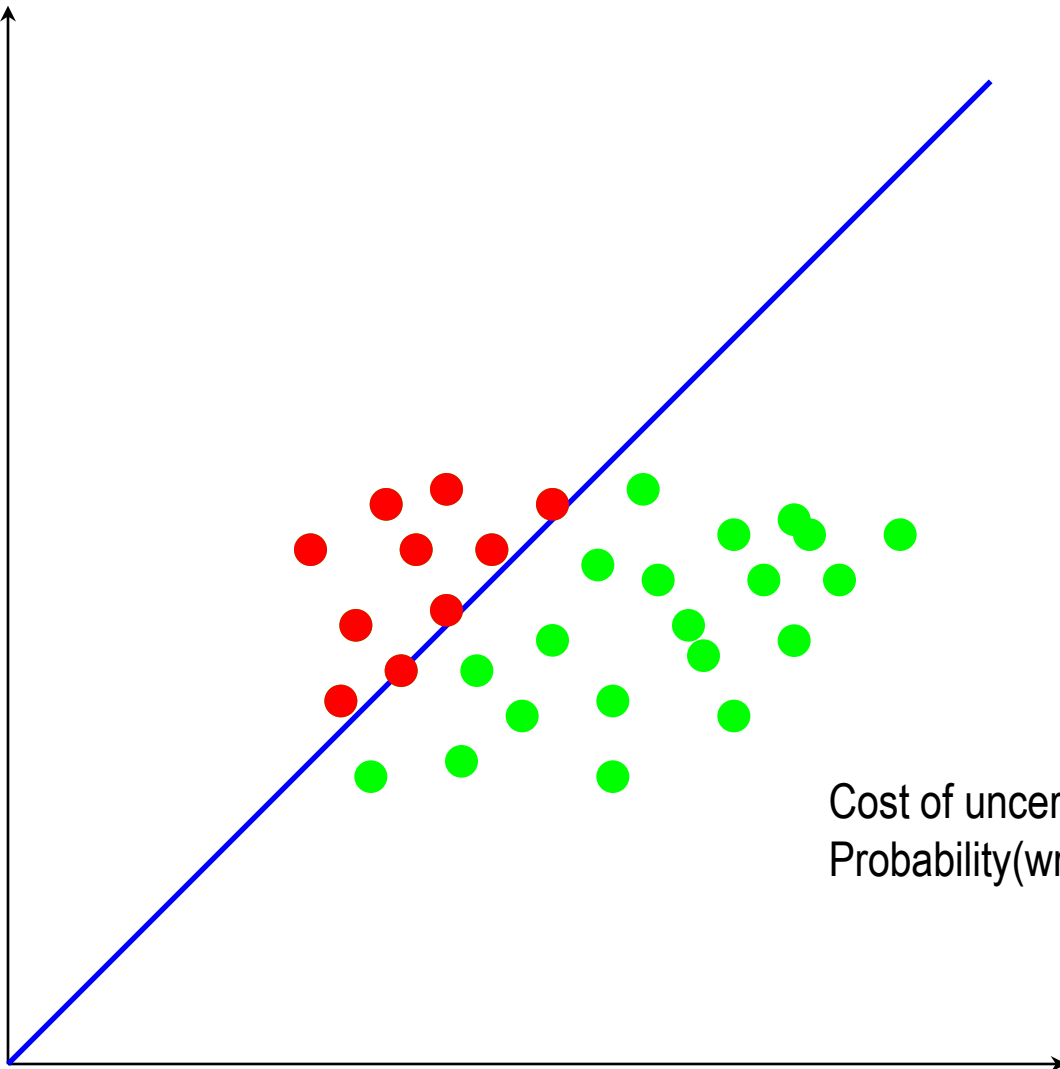
- Inadequate information
 - Poor quality evidence, suspicion of bias
 - Generalisability of evidence to practice
- To incorporate formally must assess impact on range of values for parameters



Characterising uncertainty III

- Modelling uncertainty
 - Assumptions required to synthesise data from multiple sources
 - Assumptions required to extrapolate
 - Structure of decision model
 - E.g. health states in a Markov model
- To incorporate formally must assess probability that each assumption is appropriate

resources



Cost of uncertainty =
Probability(wrong)*Consequences(if wrong)

Costs of uncertainty

- Total cost of uncertainty can be broken down into uncertainty associated with each parameter
- Estimate cost of uncertainty that is attributable to:
 - Uncertainty in costs, effectiveness, in quality of life, and so on...
- For each parameter there will be a different potential for research and appropriate research design

Possibility of research

- Some research designs unfeasible
 - Unethical (e.g. smoking, pregnancy), impractical
- Type of research will determine
 - Amount by which uncertainty reduced, costs
- Possibility of research affected by decision to invest
 - RCT may be impossible once programme in use
 - Prospective observational design initiated before investment decision may provide better quality data than retrospective

Summary

- Compare health gained with new programme or further evidence to health forgone to fund investment
- Estimate costs and effects of programmes and cost of decision uncertainty
 - Search for available data, use expert opinion and appropriate methods of elicitation
 - Characterise uncertainty, impact of poor quality, other sources of uncertainty
- Engage with decision makers
 - Characterise objectives, appropriateness of model and assumptions
 - Accurately represent assumptions that must underlie informal analysis
 - Provide explicit, transparent, consistent framework on which to base decisions