Aspects of Decision Making in Cost-effectiveness Modelling

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(with thanks to Gianluca Baio, Chris Jackson, Nicky J. Welton, Mark Strong, Anna Heath)

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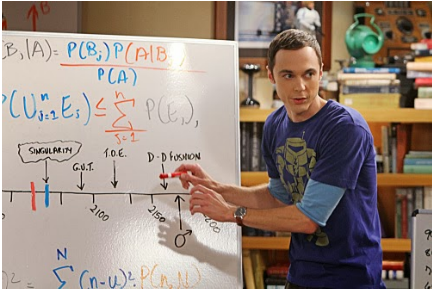
Preliminaries

University College London

- UCL was rated 2nd in the UK for research power in the Research Excellence Framework 2021
- UCL is ranked 8th in the 2022 QS World University Rankings
- The Department of Statistical Science has played a major role in the development of the subject ever since its foundation in 1911 as the Department of Applied Statistics

Objectives

Lectures



- Introduction to *Health economics modelling*
  - Decision trees
  - Markov models

- Introduction to sensitivity analyses
  - Deterministic
    - One-way & multi-way
    - Scenario
  - Probabilistic

Objectives

Computer practicals

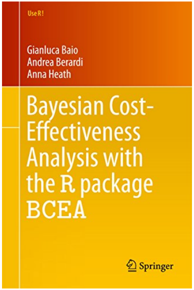
- Emphasis on practical examples
  - Decision tree and Markov models
  - using R programming language

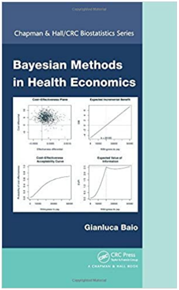
Timetable

- 0:00-1:00 Health Economics modelling lecture
- 1:00 - 1:45 Decision tree and Markov model practical
- BREAK
- 1:50 - 2:20 Sensitivity analysis
- 2:20-3:00 Sensitivity analysis practical

More Bayesian Health Economics...

Books





- This course is only a small part of an *annual week-long summer school*
  - usually in Florence, Italy
- Several books available
- Edition two of BCEA book in the pipeline and a Health Economic in R book close to being finished!

Lecture 2

Uncertainty analysis

Summary

- xxx

References

Bayesian Methods in Health Economics, chapter 1.
Baio et al (2017). *Bayesian Cost-Effectiveness Analysis with the* R *package* BCEA

Summary

- xxx

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Summary

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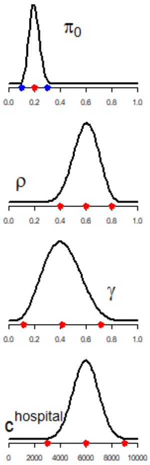
4. Uncertainty analysis

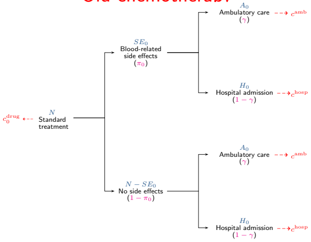
$[p(\boldsymbol{\theta} \mid e, c)$ vs $g_i(\theta_i)]$

Parameters

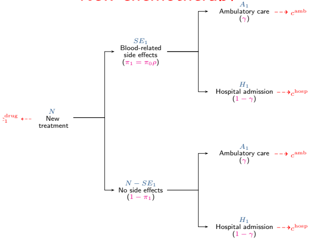


Model structure

Old chemotherapy



New chemotherapy



Decision analysis

Old chemotherapy	
Benefits	Costs

New chemotherapy	
Benefits	Costs

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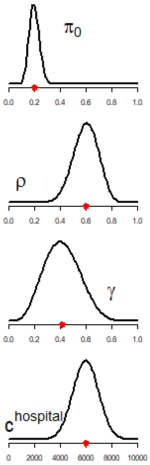
Parameters



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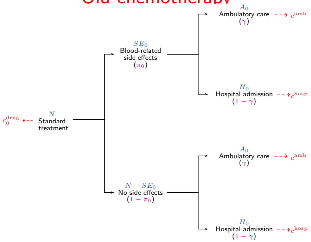
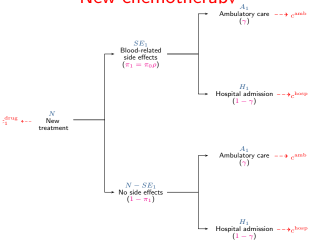


New chemotherapy



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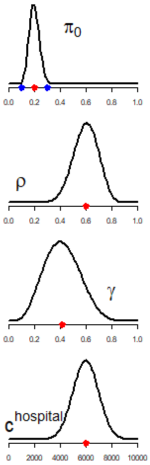

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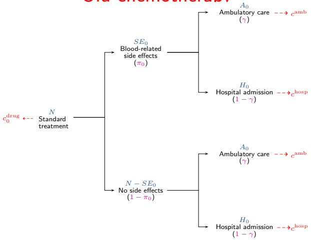

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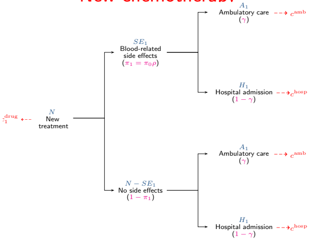

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New chemotherapy	
Benefits	Costs

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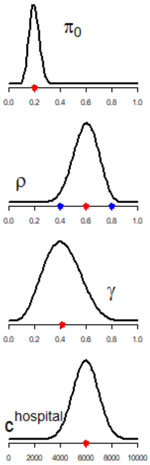

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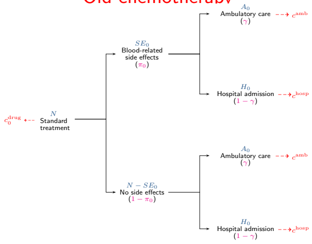

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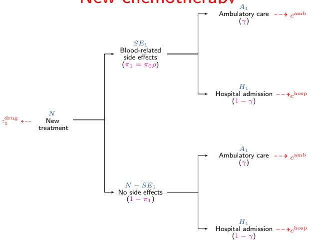

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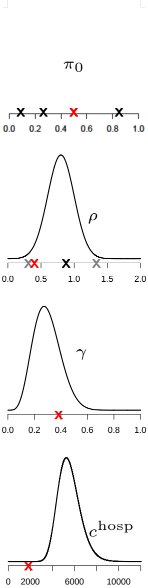

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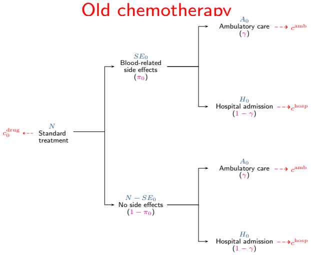
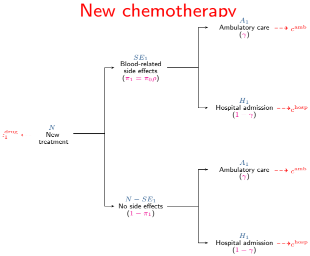


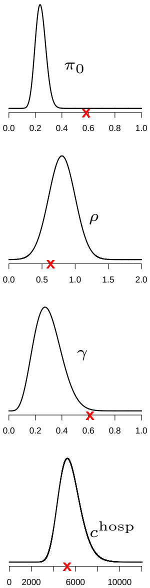


Decision analysis

Old chemotherapy	
Benefits	Costs
741	670 382.1

New chemotherapy	
Benefits	Costs
732	1 131 978

Parameters



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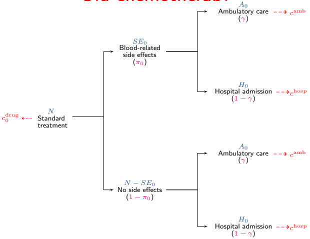
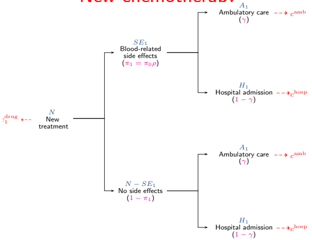
Old chemotherapy



New chemotherapy

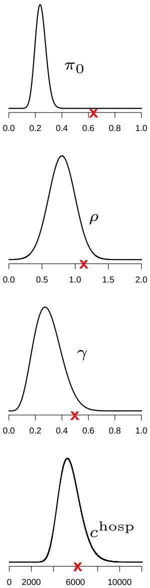


Decision analysis

Old chemotherapy	
Benefits	Costs
741	670 382.1
699	871 273.3

New chemotherapy	
Benefits	Costs
732	1 131 978
664	1 325 654

Parameters



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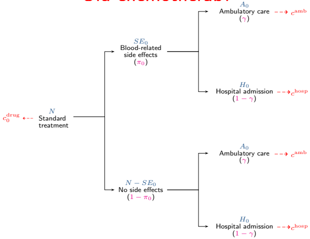
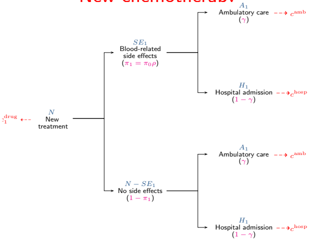


New chemotherapy



Decision analysis

Old chemotherapy	
Benefits	Costs
741	670 382.1
699	871 273.3
...	...
726	425 822.2
716.2	**790 381.2**

New chemotherapy	
Benefits	Costs
732	1 131 978
664	1 325 654
...	...
811	766 411.4
774.5	**1 066 849.8**

$$\text{ICER} = \frac{276\,468.6}{58.3} = 6\,497.1$$

Is this *all* we need? *(see VoI)*

- The CEAC only deals with the **probability** of making the "right decision"
- But it does not account for the **payoff/penalty** associated with making the "wrong" one!

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- **Example 1**: Intervention $t = 1$ is the most cost-effective, given current evidence
  - $\Pr(t = 1 \text{ is cost-effective}) = 0.51$
  - If we get it wrong: Increase in costs = £3
    Decrease in effectiveness = 0.000001 QALYs
  - Large uncertainty/negligible consequences ⇒ **can afford uncertainty**

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- **Example 1**: Intervention $t = 1$ is the most cost-effective, given current evidence
  - $\Pr(t = 1$ is cost-effective$) = 0.51$
  - If we get it wrong: Increase in costs = £3
    Decrease in effectiveness = 0.000001 QALYs
  - Large uncertainty/negligible consequences ⇒ **can afford uncertainty**

- **Example 2**: Intervention $t = 1$ is the most cost-effective, given current evidence
  - $\Pr(t = 1$ is cost-effective$) = 0.999$
  - If we get it wrong: Increase in costs = £1 000 000 000
    Decrease in effectiveness = 999999 QALYs
  - Tiny uncertainty/dire consequences ⇒ **probably should think about it...**