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## Polling

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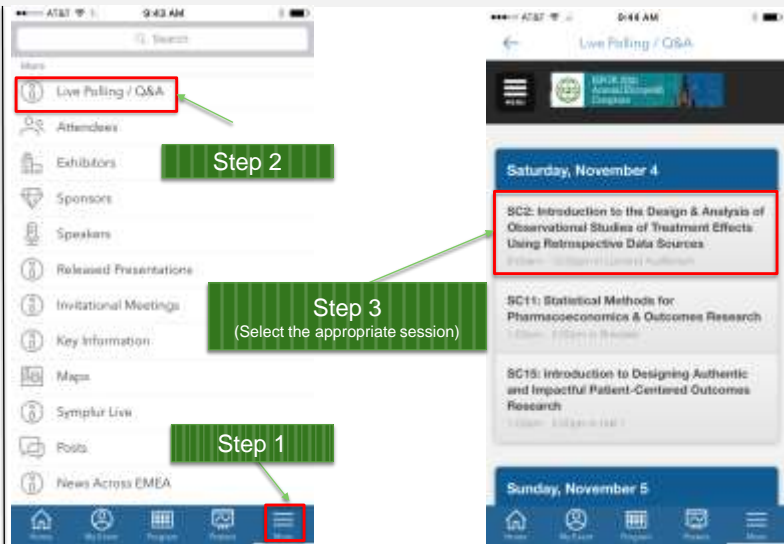


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# ARE YOU SERIOUSLY STILL USING EXCEL?

## THE MANY ADVANTAGES OF OPEN SOURCE DECISION MODELLING IN EFFICIENT PROGRAMMING LANGUAGES

## Speakers

- > Jeroen Jansen PhD
  - > The Innovation and Value Initiative
  - > Precision Xtract / Precision Health Economics
  - > Department of Health Policy & Research (Epidemiology), Stanford University School of Medicine
  
- > Gianluca Baio PhD
  - > Department of Statistical Science, University College London
  
- > Howard Thom PhD
  - > Bristol Medical School, Population Health Sciences, University of Bristol
  
- > Devin Inceri PhD
  - > The Innovation and Value Initiative
  - > Precision Health Economics

### *Live Content Slide*

*When playing as a slideshow, this slide will display live content*

**Poll: What software do you mostly use for cost-effectiveness analysis?**

*Live Content Slide*

*When playing as a slideshow, this slide will display live content*

## **Poll: Do you think R is better for cost-effectiveness analysis and modelling than Excel?**



**IVI**  INNOVATION AND  
VALUE INITIATIVE

### **Why still Excel?**

Jeroen P Jansen

[jeroen.jansen@thevalueinitiative.org](mailto:jeroen.jansen@thevalueinitiative.org)

## Common practice - 2-step approach

- > Input parameter estimation (by means of evidence synthesis) with statistical software
- > Forward simulation to calculate expected outcomes (e.g. QALYs, costs, NMBs, etc.) with economic model implemented in MS Excel

## Parallel universes – parameter estimation & simulation modeling

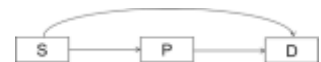
### Clinical evaluation

- Median PFS
- Median OS
- Hazard ratios
- 1-year survival
- 2-years survival
- Etc.

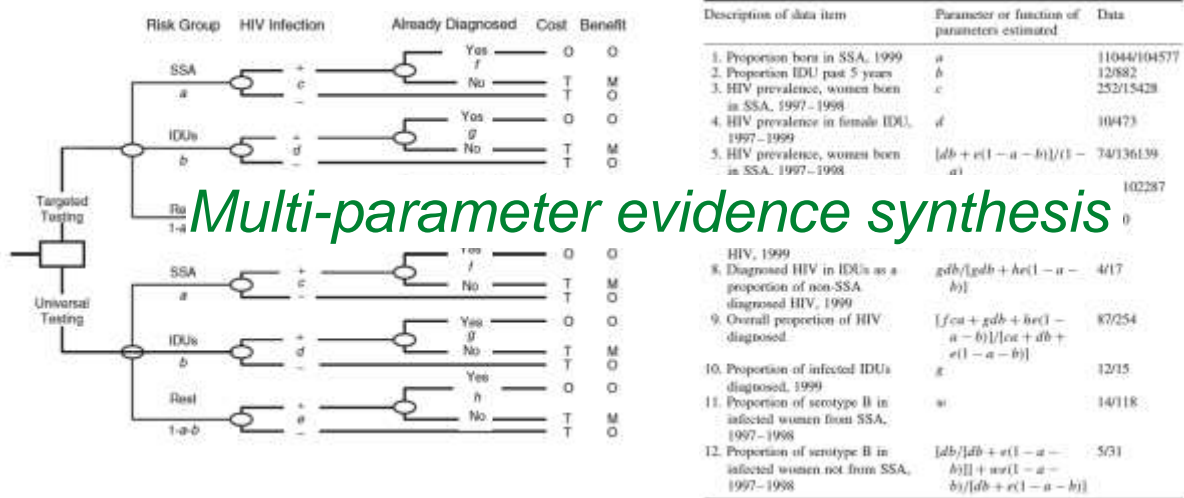


### Economic evaluation

- Expected PFS
- Expected OS
- Expected QALYs
- Difference in QALYs
- Expected costs
- Differences in costs



## Where does parameter estimation stop and (forward) simulation start? False dichotomy



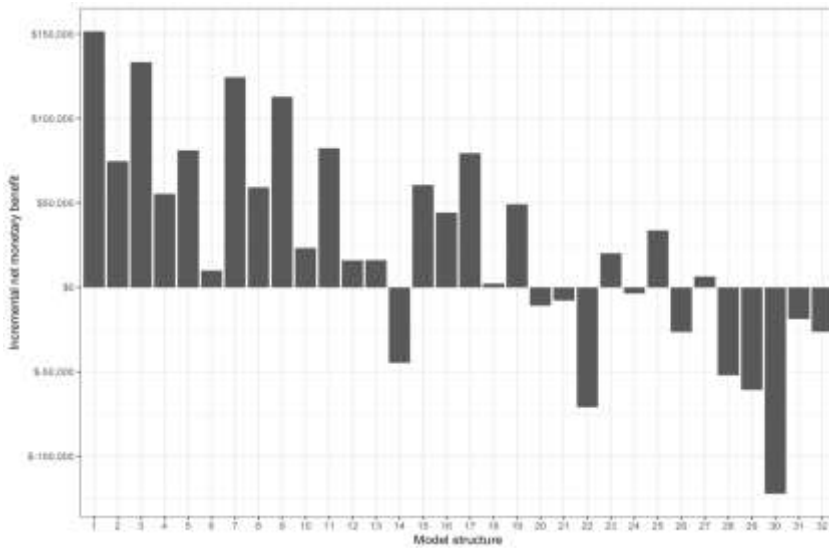
*Multi-parameter evidence synthesis*

Ades AE, Cliffe S. Markov Chain Monte Carlo estimation of a multi-parameter decision model: consistency of evidence and the accurate assessment of uncertainty. Medical Decision Making 2002;22:359-371.

## Complex models



## Quantifying decision uncertainty as a function of parameter uncertainty and structural uncertainty



## Transparency & reproducibility



# Transparency & reproducibility

**MODEL OVERVIEW**

Decision problem

Maintenance treatment & long term follow-up

Model	Standard of care	Active	Standard of care plus active
Standard of care	Grey	White	White
Active	White	Grey	White
Standard of care plus active	White	White	Grey

# Transparency & reproducibility

**ETICALLY & TRANSPARENTLY PROBABILITY HEALTH STATES**

Table 1: Summary of response and maintenance-related treatment cost outcomes. Includes columns for Health State, QALYs, Discontinuation, WHOLE cost, WHOLE QoL, and Source. Includes sub-sections for 'Cost ratio of response with induction treatment' and 'Cost ratio of maintenance with induction treatment'.

Table 2: Overall probability of continued response, relapse, discontinuation, and discontinuation with maintenance treatment. Includes columns for Health State, QALYs, Discontinuation, WHOLE cost, WHOLE QoL, and Source.

Table 3: Cost ratio of active and maintenance treatment given response with maintenance treatment. Includes columns for Health State, QALYs, Discontinuation, WHOLE cost, WHOLE QoL, and Source.

# Transparency & reproducibility

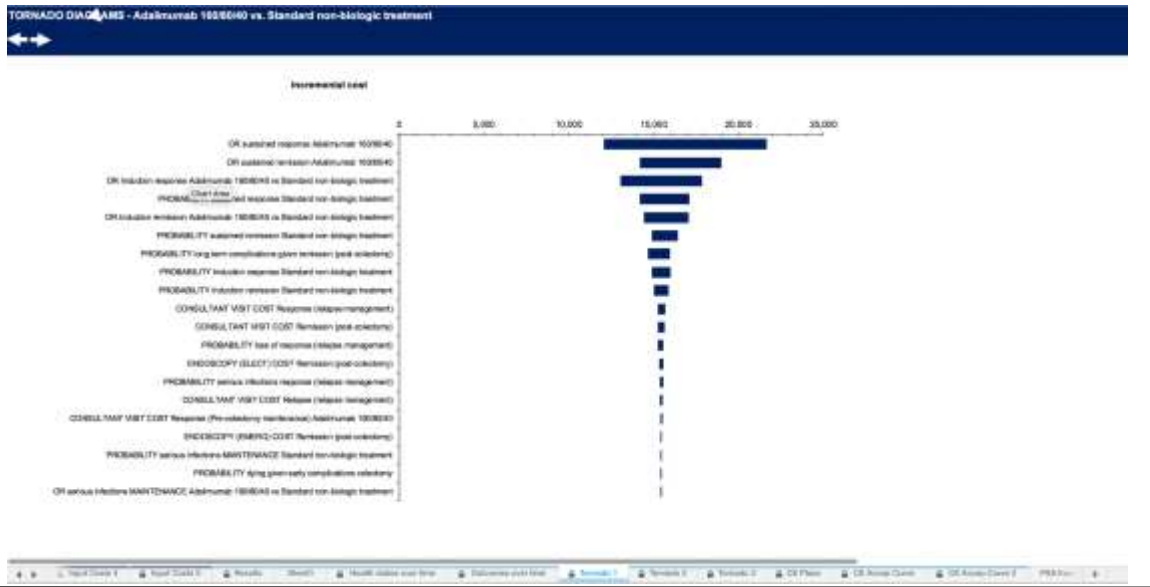
Table 1: Incremental costs and QALYs for a 10 year time horizon

	Standard non-biologic treatment				Adalimumab 160/80mg				Subcutaneous (SC) 160/80mg				Infliximab 5mg/kg				
	Mean	95% CrI	95% UI	95% LL	Mean	95% CrI	95% UI	95% LL	Mean	95% CrI	95% UI	95% LL	Mean	95% CrI	95% UI	95% LL	
Mean of inclusion and non-inclusion response (post-remission phase) in QALYs	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Cost in response in cost/yr	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Quality of life outcomes when in remission	110.0	107.0	113.0	105.0	111.0	108.0	114.0	104.0	107.0	104.0	110.0	107.0	113.0	105.0	111.0	108.0	104.0
QALY cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Incremental QALY	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Incremental drug acquisition cost (post-remission phase)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incremental therapy costs (not added to drug acquisition)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incremental response cost	0.72	0.70	0.74	0.69	0.71	0.70	0.74	0.68	0.73	0.72	0.76	0.70	0.69	0.73	0.72	0.68	0.69
Incremental response QALY	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.03	0.04	0.04	0.04	0.04	0.03	0.04	0.04	0.03	0.03
Incremental quality of life cost	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incremental quality of life QALY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incremental response cost	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Incremental costs and QALYs	1.76	1.76	1.76	1.69	1.76	1.76	1.76	1.68	1.76	1.76	1.76	1.76	1.69	1.76	1.76	1.69	1.69
Incremental utility QALY	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
Incremental net value cost	17.50	17.50	17.50	17.00	17.50	17.50	17.50	17.00	17.50	17.50	17.50	17.50	17.00	17.50	17.50	17.00	17.00
Net monetary benefit at WTP of \$50k	16.00	16.00	16.00	15.50	16.00	16.00	16.00	15.50	16.00	16.00	16.00	16.00	15.50	16.00	16.00	15.50	15.50

Table 2: Primary components incremental costs, QALYs and net monetary benefit for a 10 year time horizon

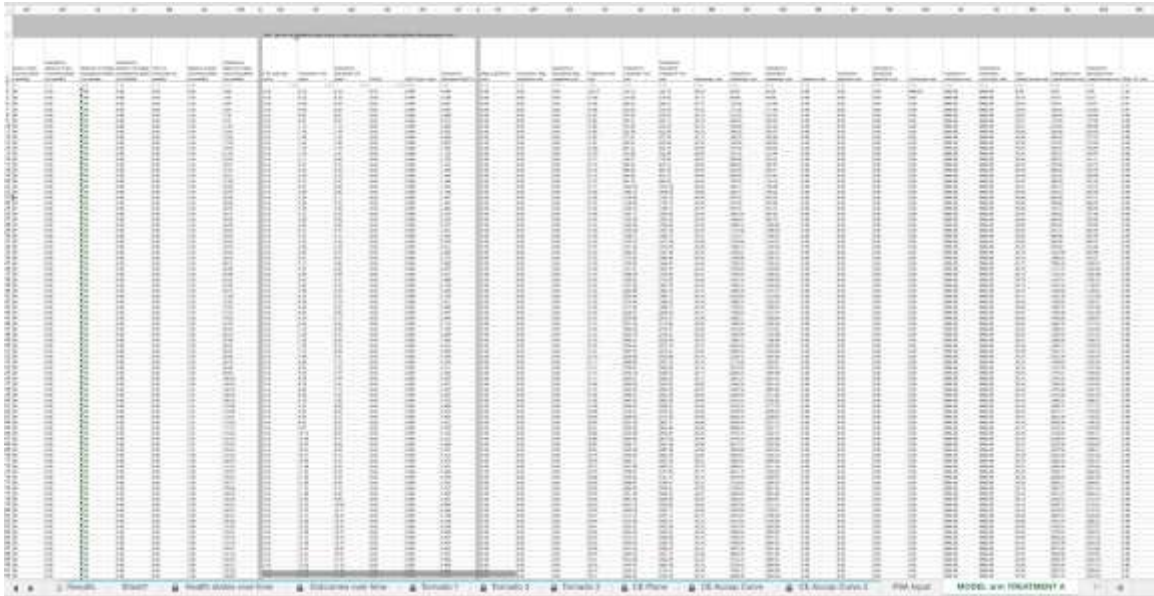
	Incremental incremental costs (net)				Incremental incremental QALYs				Incremental net monetary benefit			
	Mean	95% CrI	95% UI	95% LL	Mean	95% CrI	95% UI	95% LL	Mean	95% CrI	95% UI	95% LL
Incremental 160/80mg vs. Standard non-biologic treatment	14.66	14.58	14.74	14.57	0.00	0.00	0.00	0.00	16.00	15.92	16.08	15.85
Incremental 160/80mg vs. Standard non-biologic treatment	14.66	14.58	14.74	14.57	0.00	0.00	0.00	0.00	16.00	15.92	16.08	15.85
Incremental 5mg/kg vs. Standard non-biologic treatment	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Incremental 160/80mg vs. Incremental 5mg/kg	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00

# Transparency & reproducibility





# Transparency & reproducibility

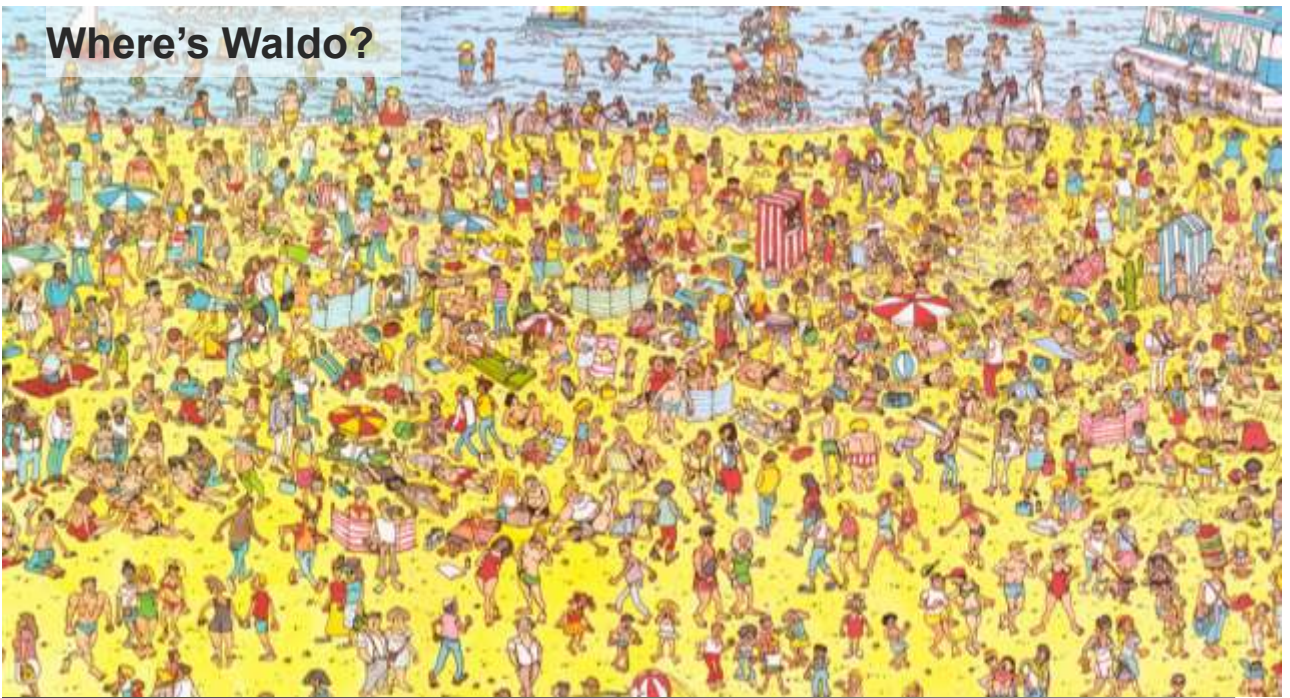


A screenshot of a complex spreadsheet with many columns and rows. The columns are labeled with various categories, and the rows contain data. The spreadsheet is divided into several sections, with some columns highlighted in green. The bottom of the spreadsheet shows a navigation bar with several tabs, including 'Health', 'Economic', 'Health status over time', 'Disability over time', 'Scenario 1', 'Scenario 2', 'Scenario 3', '1.8 Policy', '1.8 Results - Latin', '1.8 Results - Europe', 'PMA Input', and 'MODEL WITH TREATMENT A'.

IVI \*

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Where's Waldo?



IVI \*

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## What do we mean by model transparency?

- > Concept, math
  - > Face validity
  - > Implementation/programming
  - > ...
  - > *Familiarity with software?*
- 
- > Open-source

## Alternative



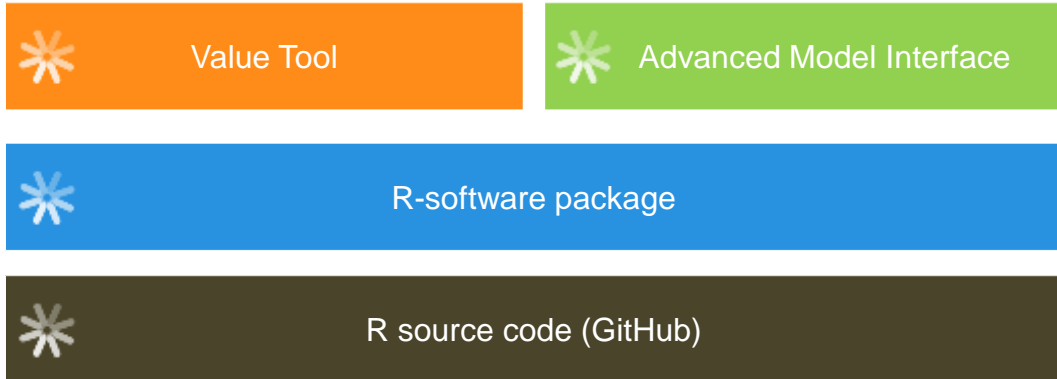
BCEA

HEEMOD

HESIM

...

## R-based models are not only syntax



<https://innovationandvalueinitiative.shinyapps.io/ivi-ra-expert/>

## Time to change

