R you *seriously* still using Excel?

The many advantages of open source decision modelling in efficient programming languages

Gianluca Baio

University College London
Department of Statistical Science

g.baio@ucl.ac.uk
http://www.ucl.ac.uk/statistics/research/statistics-health-economics/
http://www.statistica.it/gianluca
https://github.com/StatisticsHealthEconomics
https://github.com/giabaio
@gianlubaio

(With contributions by Andrea Berardi, Andrea Gabrio, Anna Heath, Christina Ding, Nathan Green et al)

NHS-R COMMUNITY Virtual Conference 2020 #nhsrconf2020

Wednesday 11 November 2020

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Manuela Joore
@ManuelaJoore

Best opening sentence #ISPOREurope from Gianluca Baio: "statisticians should rule the world and Bayesian statisticians should rule all statisticians"

> **Gianluca Baio** @gianlubaio · Nov 4, 2019
> Ready for our session on open siurce models & methods!

4:52 PM · Nov 4, 2019 · Twitter for iPhone

2 Retweets **16** Likes

Ed Wilson @EdCFWilson · Nov 4, 2019
Replying to @ManuelaJoore and @gianlubaio
And economists should rule the Bayesian statisticians 👴
1 4

Gianluca Baio @gianlubaio · Nov 4, 2019
Now don't get ahead of yourself... 😂 😂
3

James Shearer 🌈🎻 @DrJamesDShearer · Nov 4, 2019
Replying to @ManuelaJoore
One ring to rule them all, one ring to find them, One ring to bring them all and in the darkness bind them 🧙‍♂️
1

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Professor Health Technology Assessment & Decision Making. Dep. head KEMTA @maastrichtumc @maastrichtu @CAPHRI_UM, and @ZINlactueel & @NICEcomms

Gianluca Baio
@gianlubaio
I'm a professor of Statistics & Health Economics at University College London. And the coach of my son's 5-a-side team --- in the Champion's League in 3 years.

London trends

1 · Trending
#Marmot2020
13.8K Tweets

Health
Influential review in England finds that regional health ...

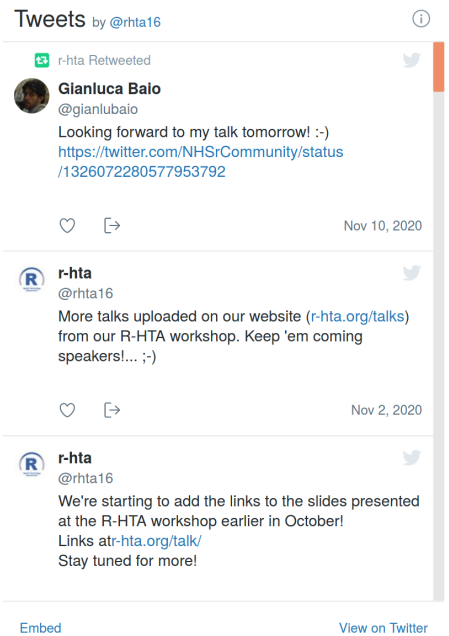
Mark Sculpher, Gemma Shields, and 2 more are Tweeting about this

2 · Trending
#digileaders

Mission

R for Health Technology Assessment (HTA) is an academic consortium whose main objective is to explore the use of R for cost-effectiveness analysis (CEA) as an alternative to less efficient, generalisable and powerful software such as spreadsheets. R is a freely available language and environment for statistical computing and graphics which provides a wide variety of statistical and graphical techniques. We advocate the use of proper statistical software, notably R, to be used in the whole process of health economic evaluation.

General topics of interest include a wide range of technical aspects, e.g. the discussion of the many available R add-on packages, as well as ways to help users get the most out of R for CEA. Presentations and public discussions are used to address the computational and transparency advantages of R over `Excel` for CEA and for easing collaboration. Our members have diverse experience in government (including NICE in the UK), academia, and industry.



Events

Our events, including the annual workshop, short courses and hackathons

HACKATHONS

Come and play with R!

Health technology assessment (HTA)

Objective: Combine costs & benefits of a given intervention into a rational scheme for allocating resources

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Statistical model

- Estimates relevant **population** parameters $\boldsymbol{\theta}$
- Varies with the type of available data (& statistical approach!)

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$$\Delta_e = f_e(\boldsymbol{\theta})$$
$$\Delta_c = f_c(\boldsymbol{\theta})$$

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- Combines the parameters to obtain a population average measure for costs and clinical benefits
- Varies with the type of available data & statistical model used

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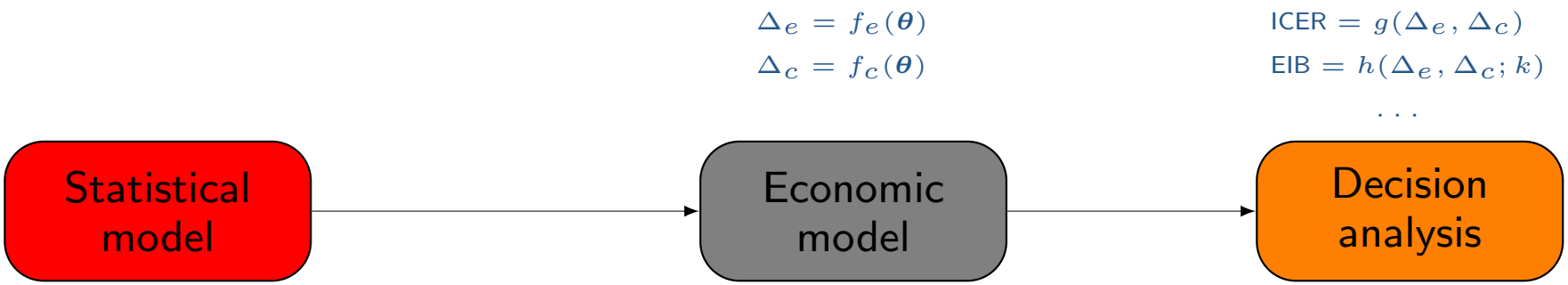

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- Dictates the best course of actions, given current evidence
- Standardised process

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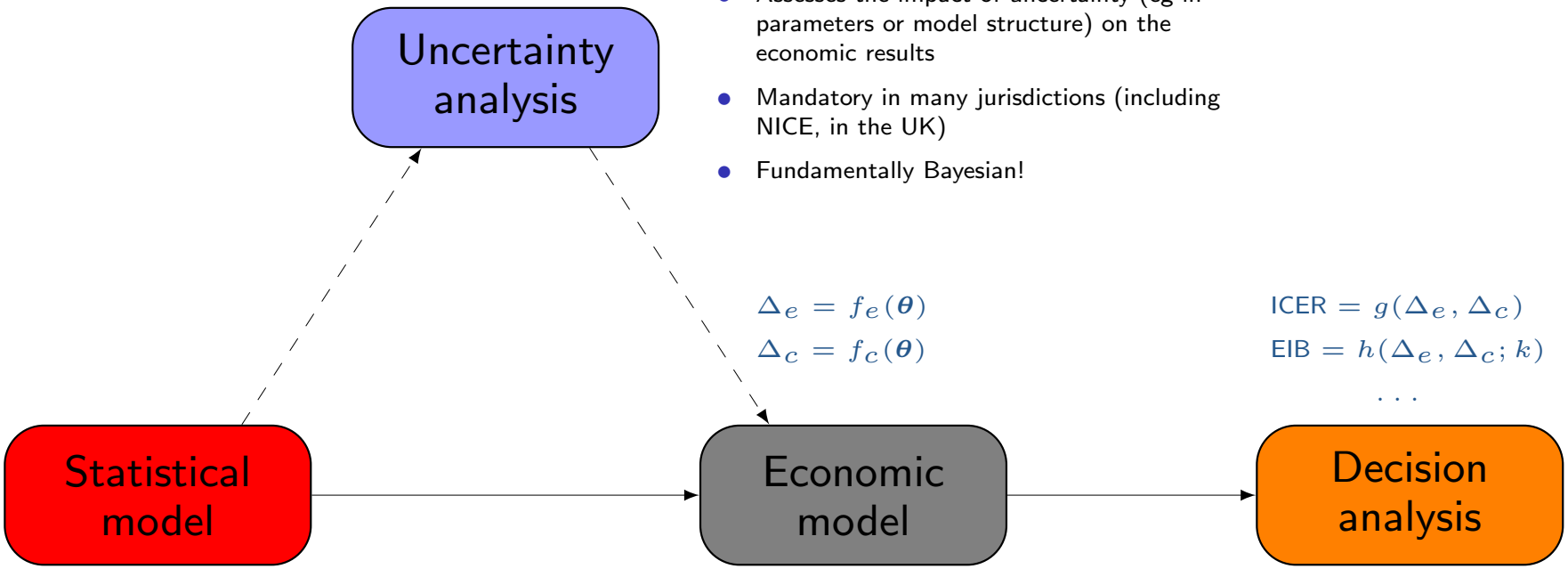

- Assesses the impact of uncertainty (eg in parameters or model structure) on the economic results
- Mandatory in many jurisdictions (including NICE, in the UK)
- Fundamentally Bayesian!

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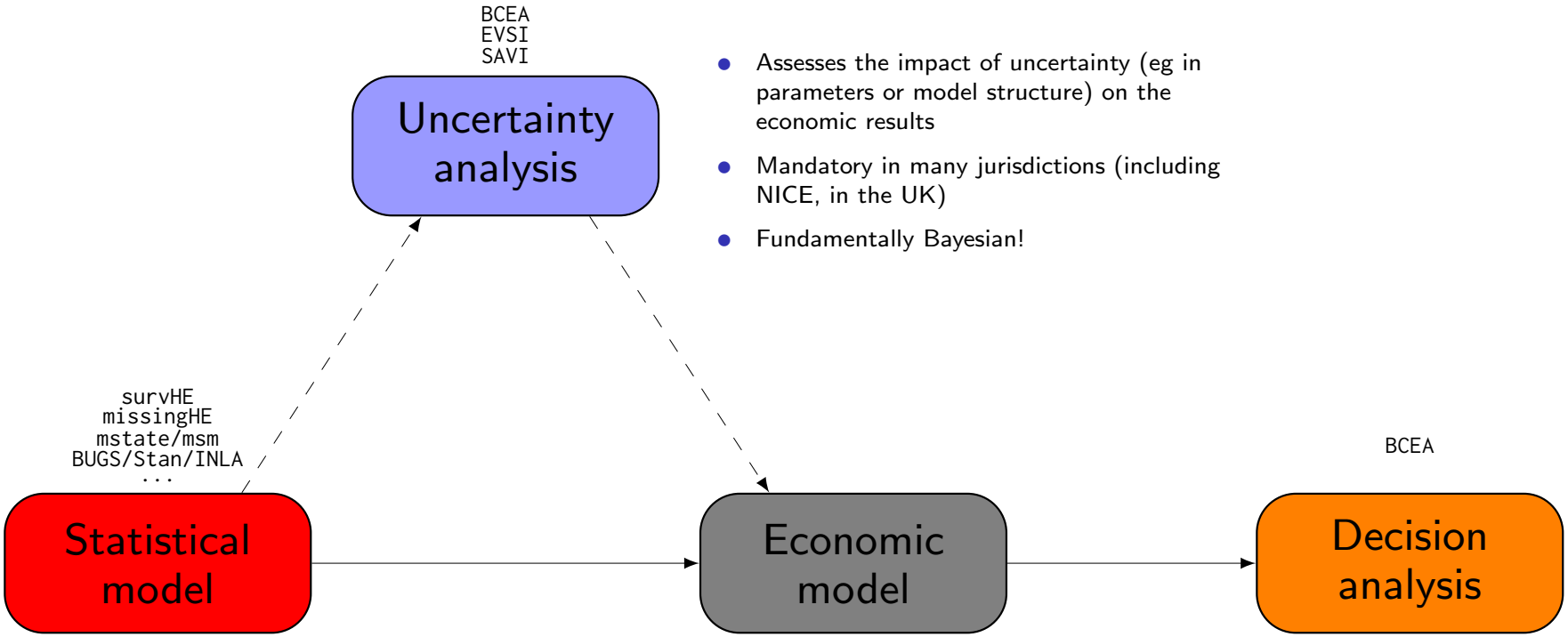
For each module, we may need/use different/specific packages! (the "R-HTA-verse"?)



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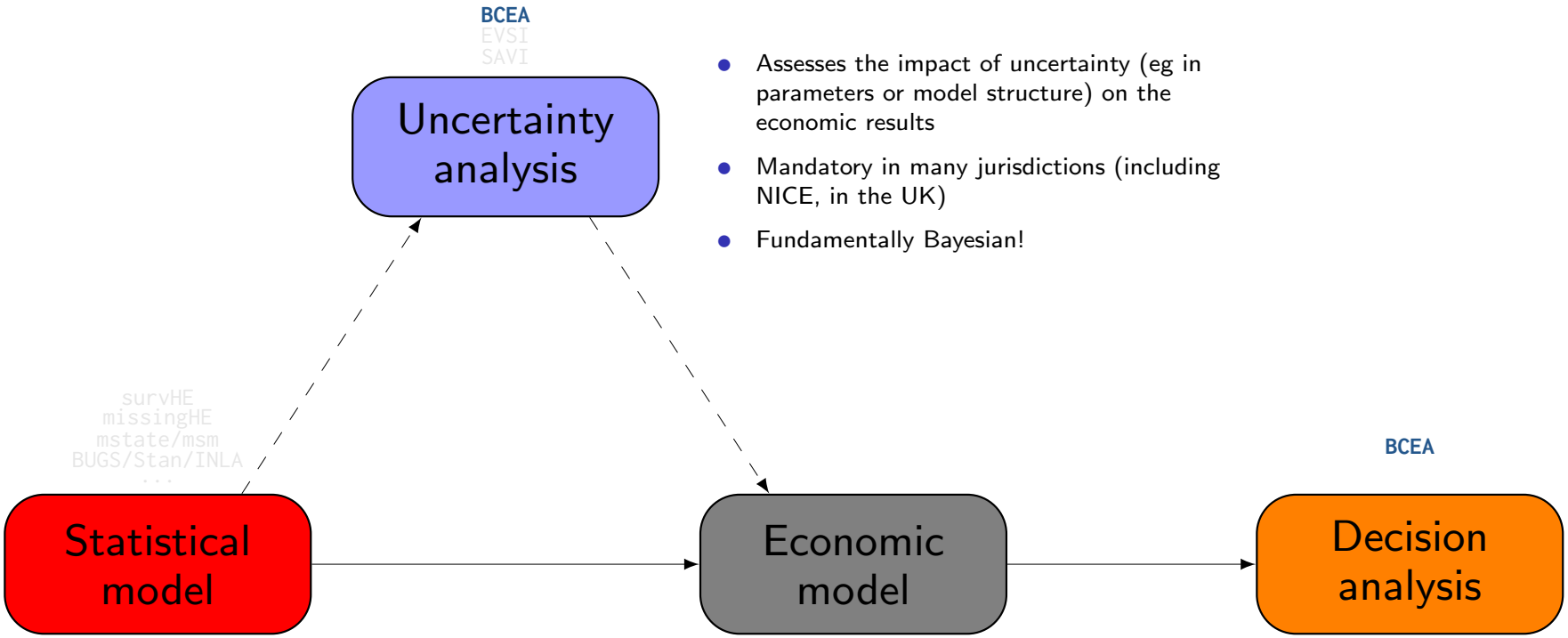

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BCEA: a R package for Bayesian cost-effectiveness analysis

BCEA & its use directly in R are designed with these objectives in mind

0. Checking the model assumptions — Throughout — Uncertainty analysis
   - Do we mean what we mean (eg in terms of PSA simulations)?...
   - Simulation error (especially, **but not only**, for a Bayesian approach)

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   - Fairly easy (but not always used): CEAF
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3. Standardised reporting — Throughout
   - Graphical tools (use **excellent** R facilities)

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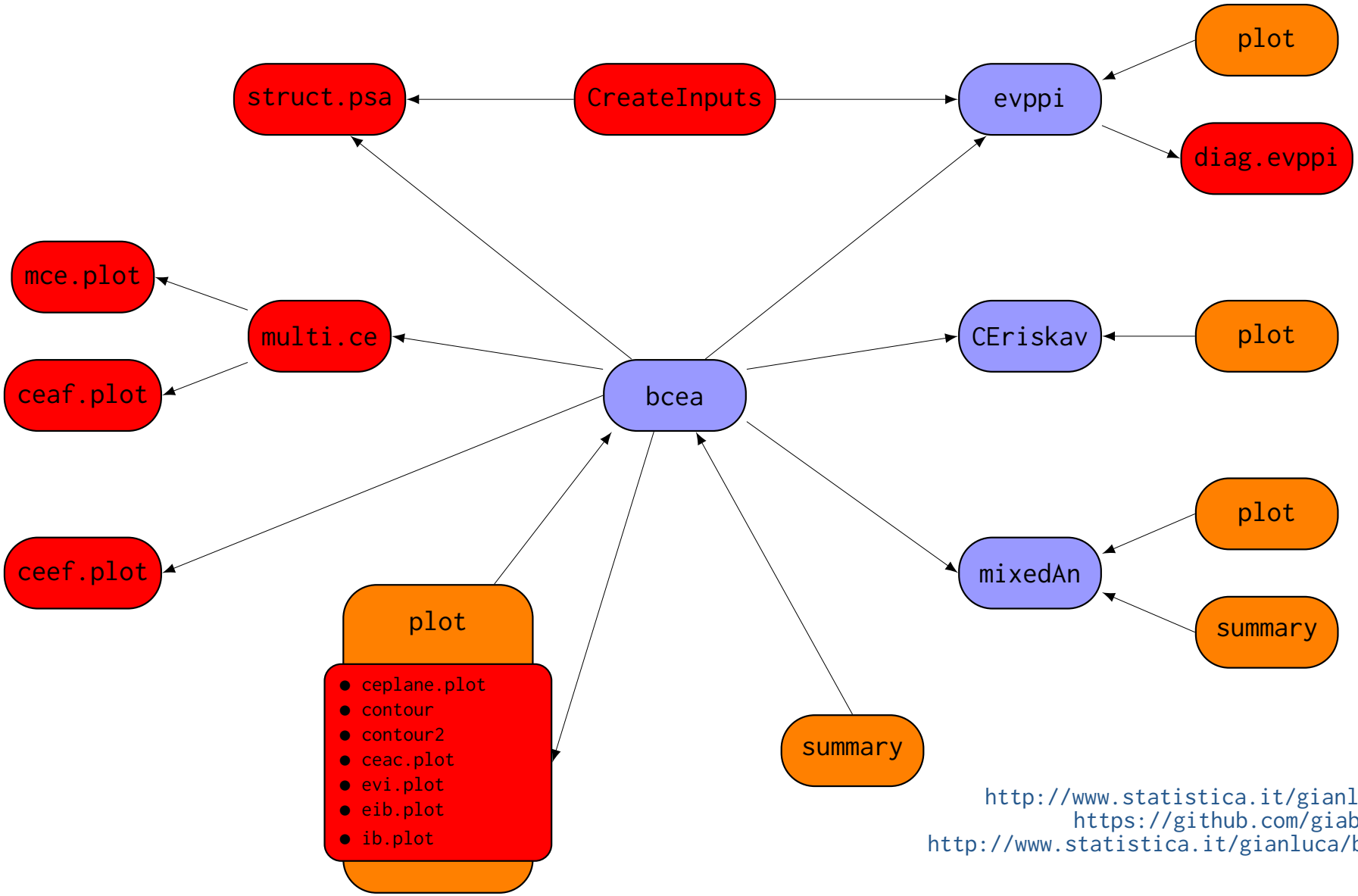
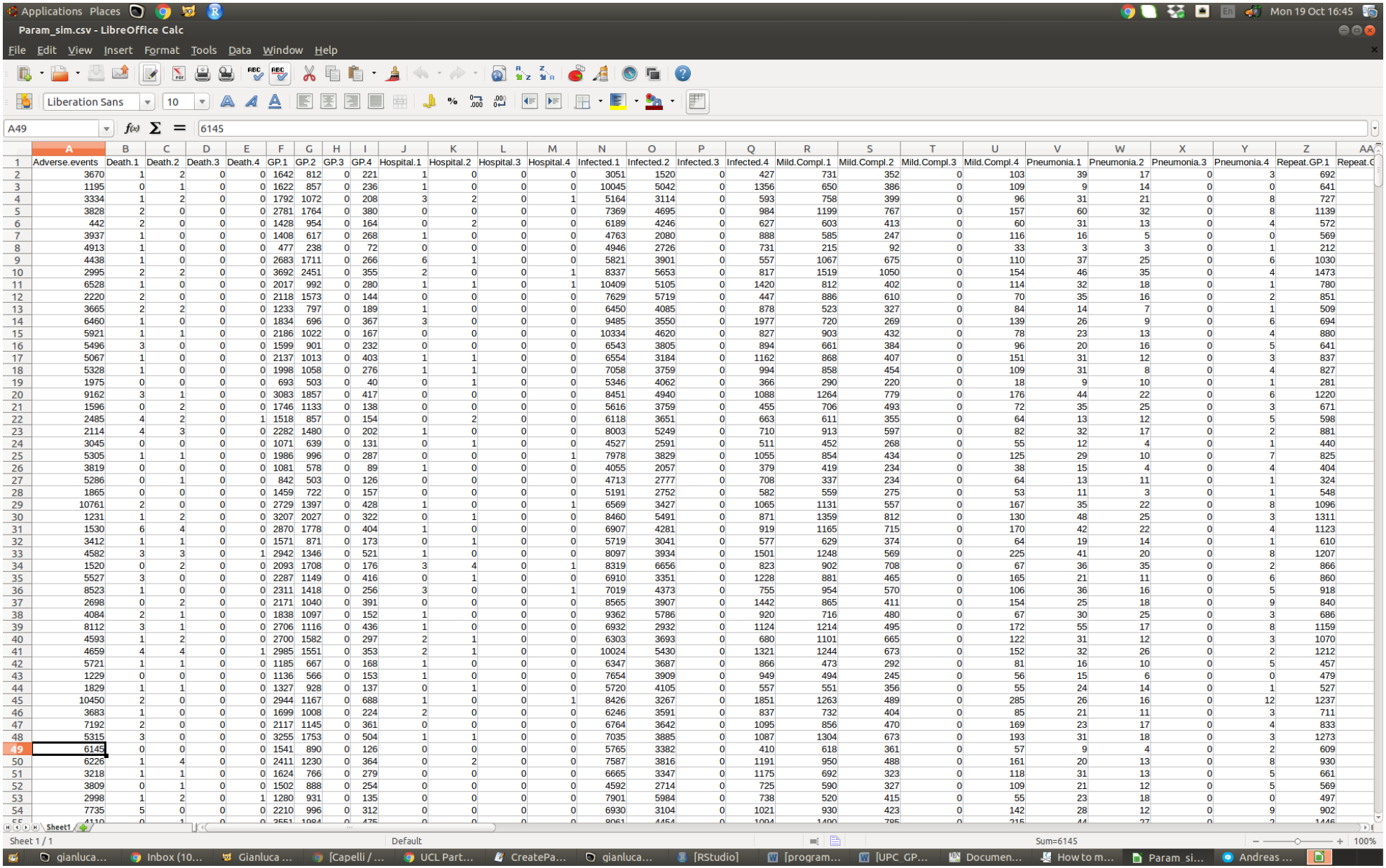


http://www.statistica.it/gianluca/BCEA
https://github.com/giabaio/BCEA
http://www.statistica.it/gianluca/book/bcea

How does BCEA work?

Model inputs ("PSA simulations")


Applications Places

Mon 19 Oct 16:45

Param_sim.csv - LibreOffice Calc

File Edit View Insert Format Tools Data Window Help

Liberation Sans 10

A49 6145

	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P	Q	R	S	T	U	V	W	X	Y	Z	AA
1	Adverse.events	Death.1	Death.2	Death.3	Death.4	GP.1	GP.2	GP.3	GP.4	Hospital.1	Hospital.2	Hospital.3	Hospital.4	Infected.1	Infected.2	Infected.3	Infected.4	Mild.Compl.1	Mild.Compl.2	Mild.Compl.3	Mild.Compl.4	Pneumonia.1	Pneumonia.2	Pneumonia.3	Pneumonia.4	Repeat.GP.1	Repeat.C
2	3670	1	2	0	0	1642	812	0	221	1	0	0	0	3051	1520	0	427	731	352	0	103	39	17	0	3	692	
3	1195	0	1	0	0	1622	857	0	236	1	0	0	0	10045	5042	0	1356	650	386	0	109	9	14	0	0	641	
4	3334	1	2	0	0	1792	1072	0	208	3	2	0	1	5164	3114	0	593	758	399	0	96	31	21	0	8	727	
5	3828	2	0	0	0	2781	1764	0	380	0	0	0	0	7369	4695	0	984	1199	767	0	157	60	32	0	8	1139	
6	442	2	0	0	0	1428	954	0	164	0	2	0	0	6189	4246	0	627	603	413	0	60	31	13	0	4	572	
7	3937	1	0	0	0	1408	617	0	268	1	0	0	0	4763	2080	0	888	585	247	0	116	16	5	0	0	569	
8	4913	1	0	0	0	477	238	0	72	0	0	0	0	4946	2726	0	731	215	92	0	33	3	3	0	1	212	
9	4438	1	0	0	0	2683	1711	0	266	6	1	0	0	5821	3901	0	557	1067	675	0	110	37	25	0	6	1030	
10	2995	2	2	0	0	3692	2451	0	355	2	0	0	1	8337	5653	0	817	1519	1050	0	154	46	35	0	4	1473	
11	6528	1	0	0	0	2017	992	0	280	1	1	0	1	10409	5105	0	1420	812	402	0	114	32	18	0	1	780	
12	2220	2	0	0	0	2118	1573	0	144	0	0	0	0	7629	5719	0	447	886	610	0	70	35	16	0	2	851	
13	3665	2	2	0	0	1233	797	0	189	1	0	0	0	6450	4085	0	878	523	327	0	84	14	7	0	1	509	
14	6460	1	0	0	0	1834	696	0	367	3	0	0	0	9485	3550	0	1977	720	269	0	139	26	9	0	6	694	
15	5921	1	1	0	0	2186	1022	0	167	0	0	0	0	10334	4620	0	827	903	432	0	78	23	13	0	4	880	
16	5496	3	0	0	0	1599	901	0	232	0	0	0	0	6543	3805	0	894	661	384	0	96	20	16	0	5	641	
17	5067	1	0	0	0	2137	1013	0	403	1	1	0	0	6554	3184	0	1162	868	407	0	151	31	12	0	3	837	
18	5328	1	0	0	0	1998	1058	0	276	1	1	0	0	7058	3759	0	994	858	454	0	109	31	8	0	4	827	
19	1975	0	0	0	0	693	503	0	40	0	1	0	0	5346	4062	0	366	290	220	0	18	9	10	0	1	281	
20	9162	3	1	0	0	3083	1857	0	417	0	0	0	0	8451	4940	0	1088	1264	779	0	176	44	22	0	6	1220	
21	1596	0	2	0	0	1746	1133	0	138	0	0	0	0	5616	3759	0	455	706	493	0	72	35	25	0	3	671	
22	2485	4	2	0	1	1518	857	0	154	0	2	0	0	6118	3651	0	663	611	355	0	64	13	12	0	5	598	
23	2114	4	3	0	0	2282	1480	0	202	1	0	0	0	8003	5249	0	710	913	597	0	82	32	17	0	2	881	
24	3045	0	0	0	0	1071	639	0	131	0	1	0	0	4527	2591	0	511	452	268	0	55	12	4	0	1	440	
25	5305	1	1	0	0	1986	996	0	287	0	0	0	1	7978	3829	0	1055	854	434	0	125	29	10	0	7	825	
26	3819	0	0	0	0	1081	578	0	89	1	0	0	0	4055	2057	0	379	419	234	0	38	15	4	0	4	404	
27	5286	0	1	0	0	842	503	0	126	0	0	0	0	4713	2777	0	708	337	234	0	64	13	11	0	1	324	
28	1865	0	0	0	0	1459	722	0	157	0	0	0	0	5191	2752	0	582	559	275	0	53	11	3	0	1	548	
29	10761	2	0	0	0	2729	1397	0	428	1	0	0	1	6569	3427	0	1065	1131	557	0	167	35	22	0	8	1096	
30	1231	1	2	0	0	3207	2027	0	322	0	1	0	0	8460	5491	0	871	1359	812	0	130	48	25	0	3	1311	
31	1530	6	4	0	0	2870	1778	0	404	1	0	0	0	6907	4281	0	919	1165	715	0	170	42	22	0	4	1123	
32	3412	1	1	0	0	1571	871	0	173	0	1	0	0	5719	3041	0	577	629	374	0	64	19	14	0	1	610	
33	4582	3	3	0	1	2942	1346	0	521	1	0	0	0	8097	3934	0	1501	1248	569	0	225	41	20	0	8	1207	
34	1520	0	2	0	0	2093	1708	0	176	3	4	0	1	8319	6656	0	823	902	708	0	67	36	35	0	2	866	
35	5527	3	0	0	0	2287	1149	0	416	0	1	0	0	6910	3351	0	1228	881	465	0	165	21	11	0	6	860	
36	8523	1	0	0	0	2311	1418	0	256	3	0	0	1	7019	4373	0	755	954	570	0	106	36	16	0	5	918	
37	2698	0	2	0	0	2171	1040	0	391	0	0	0	0	8565	3907	0	1442	865	411	0	154	25	18	0	9	840	
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39	8112	3	1	0	0	2706	1116	0	436	1	0	0	0	6932	2932	0	1124	1214	495	0	172	55	17	0	8	1159	
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42	5721	1	1	0	0	1185	667	0	168	1	0	0	0	6347	3687	0	866	473	292	0	81	16	10	0	5	457	
43	1229	0	0	0	0	1136	566	0	153	1	0	0	0	7654	3909	0	949	494	245	0	56	15	6	0	0	479	
44	1829	1	1	0	0	1327	928	0	137	0	1	0	0	5720	4105	0	557	551	356	0	55	24	14	0	1	527	
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46	3683	1	0	0	0	1699	1008	0	224	2	0	0	0	6246	3591	0	837	732	404	0	85	21	11	0	3	711	
47	7192	2	0	0	0	2117	1145	0	361	0	0	0	0	6764	3642	0	1095	856	470	0	169	23	17	0	4	833	
48	5315	3	0	0	0	3255	1753	0	504	1	1	0	0	7035	3885	0	1087	1304	673	0	193	31	18	0	3	1273	
49	6145	0	0	0	0	1541	890	0	126	0	0	0	0	5765	3382	0	410	618	361	0	57	9	4	0	2	609	
50	6226	1	4	0	0	2411	1230	0	364	0	2	0	0	7587	3816	0	1191	950	488	0	161	20	13	0	8	930	
51	3218	1	1	0	0	1624	766	0	279	0	0	0	0	6665	3347	0	1175	692	323	0	118	31	13	0	5	661	
52	3809	0	1	0	0	1502	888	0	254	0	0	0	0	4592	2714	0	725	590	327	0	109	21	12	0	5	569	
53	2998	1	2	0	1	1280	931	0	135	0	0	0	0	7901	5984	0	738	520	415	0	55	23	18	0	0	497	
54	7735	5	0	0	0	2210	996	0	312	0	0	0	0	6930	3104	0	1021	930	423	0	142	28	12	0	9	902	

Sheet1

Sheet 1 / 1 Default Sum=6145 100%

gianluca... Inbox (10... Gianluca ... [Capelli /... UCL Part... CreatePa... gianluca... [RStudio] [program... [UPC_GP... Documen... How to m... Param_si... Andreas ...

```
# Loads BCEA into the R workspace
> library(BCEA)

# Loads the PSA data from the R object "Vaccine"
> data(Vaccine)

# Uses BCEA to create suitable input
> inp = CreateInputs(vaccine)
```

```
# Shows the first few rows of the PSA matrix
> head(inp$mat)

  Adverse.events Death.1.1. Death.2.1. Death.2.2. GP.1.1. GP.2.1. GP.2.2. Hospital.1.1.
1           1466          1          0          0    1664     958     230              0
2           5329          1          1          0    1414     748     276              0
3           5203          1          1          0     809     489      80              0
4           2351          2          0          0    1761    1157     261              1
5           8303          1          2          0    2472     964     432              1
6           3607          1          1          0    2224    1342     260              1
  Hospital.2.1. Hospital.2.2. Infected.1.1. Infected.2.1. Infected.2.2. Mild.Compl.1.1.
1             1             0          5992          3401           876             691
2             0             1          7471          4024          1536             570
3             0             0          6718          4300           788             332
4             0             0          4837          3269           702             739
5             1             0          4749          1894           846            1049
6             0             0          4938          2976           596             915

...

(many more rows & variables!)
```

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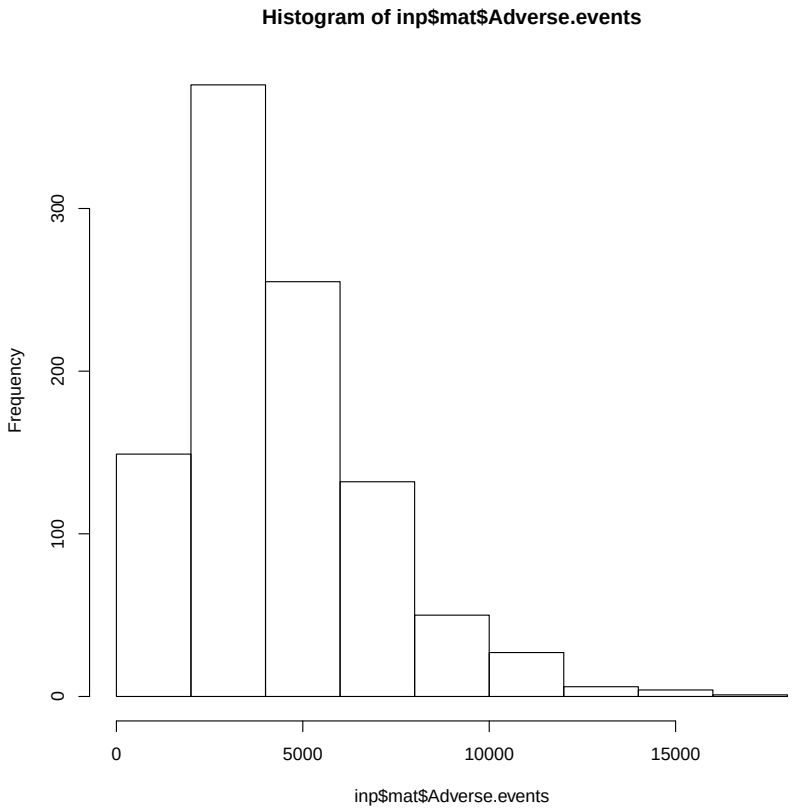
```
# Checks that the intended PSA distribution gives meaningful results
> hist(inp$mat$Adverse.events)
```



How does BCEA work?

```
# Combines the model parameters to determine costs & effectiveness
> QALYs.inf <- QALYs.pne <- QALYs.hosp <- QALYs.adv <- QALYs.death <- matrix(0,n.sims,2)
> for (t in 1:2) {
    QALYs.inf[,t] = ((Infected[,t,1] + Infected[,t,2])*omega[,1]/365)/N
    QALYs.pne[,t] = ((Pneumonia[,t,1] + Pneumonia[,t,2])*omega[,4]/365)/N
    QALYs.hosp[,t] = ((Hospital[,t,1] + Hospital[,t,2])*omega[,5]/365)/N
    QALYs.death[,t] = ((Death[,t,1] + Death[,t,2])*omega[,6])/N
  }
> QALYs.adv[,2] = (Adverse.events*omega[,7]/365)/N

> e = -(QALYs.inf + QALYs.pne + QALYs.adv + QALYs.hosp + QALYs.death)
> ...
```

```
# Displays the first few row of the matrix for (e,c) in the two treatment arms
> head(cbind(e,c))

       Status Quo   Vaccination  Status Quo Vaccination
[1,] -0.0010466668 -0.0008986026  10.409146   16.252537
[2,] -0.0008836105 -0.0007320416   5.834875    9.373437
[3,] -0.0008898137 -0.0006975327   5.784903   15.935623
[4,] -0.0016430238 -0.0011393237  12.208484   18.654250
[5,] -0.0013518841 -0.0009574948   9.786787   16.467321
[6,] -0.0014325715 -0.0009358231   6.560276    9.689887

...

(many more rows!)
```

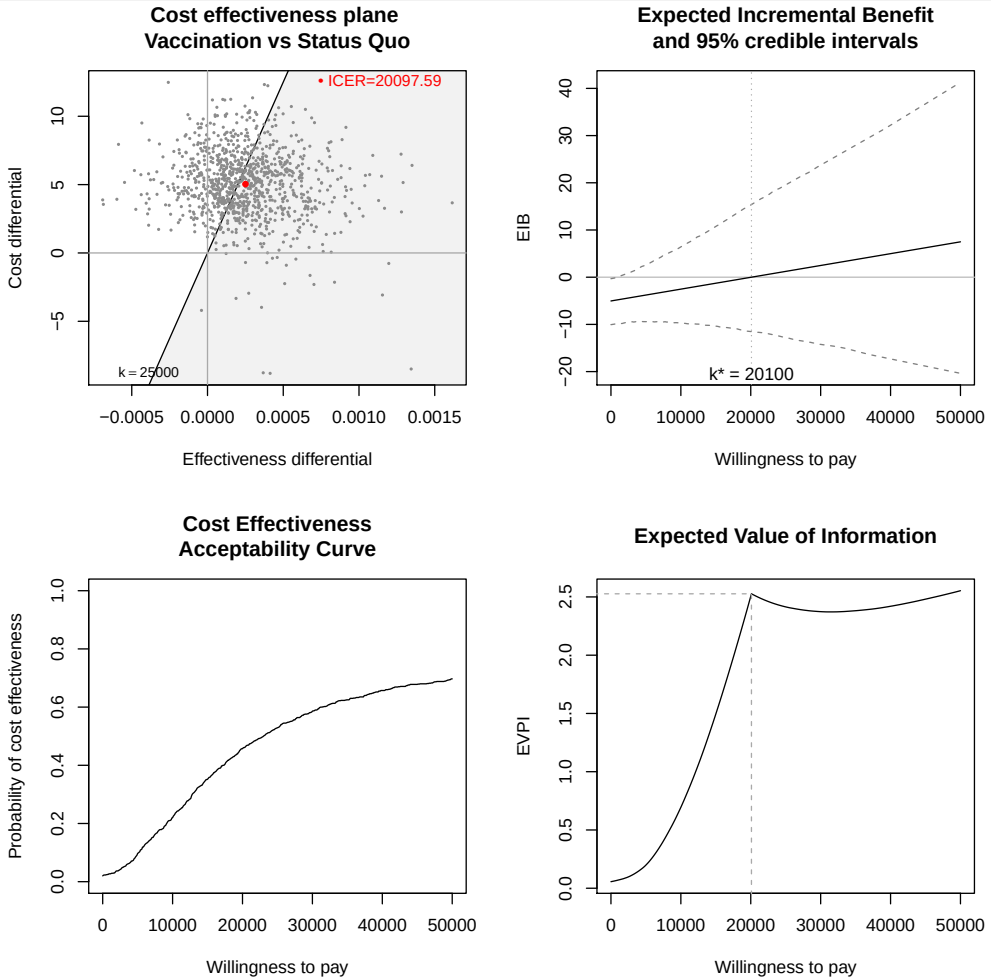
How does BCEA work?

```
# Uses BCEA to perform the decision analysis
> m = bcea(e,c,ref=2,interventions=c("Status Quo","Vaccination"),...)
```

```
# Summarises the results
> summary(m)

Cost-effectiveness analysis summary

Reference intervention:  Vaccination
Comparator intervention: Status Quo

Optimal decision: choose Status Quo for k<20100 and Vaccination for k>=20100


Analysis for willingness to pay parameter k = 25000

            Expected utility
Status Quo           -36.054
Vaccination          -34.826

                            EIB  CEAC  ICER
Vaccination vs Status Quo 1.2284 0.529 20098

Optimal intervention (max expected utility) for k=25000: Vaccination

EVPI 2.4145
```

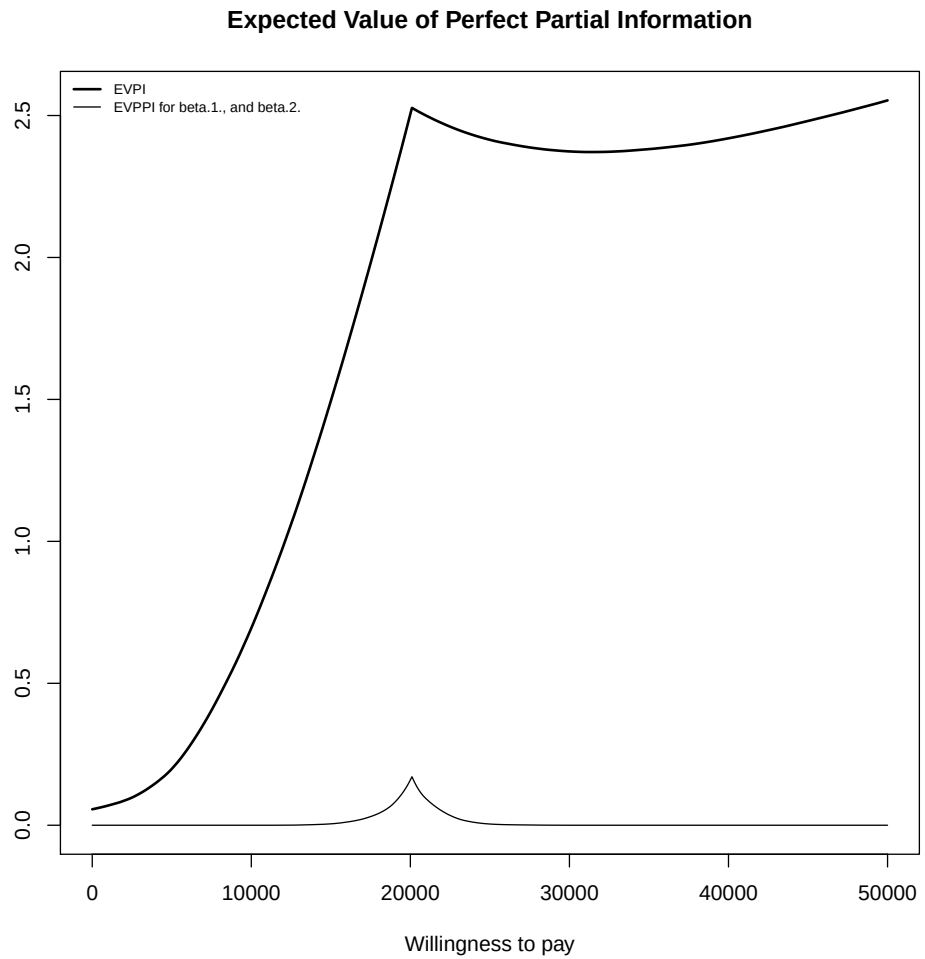
How does BCEA work?

```
# Uses BCEA to perform the decision analysis
> m = bcea(e,c,ref=2,interventions=c("Status Quo","Vaccination"),...)

# Plots the results
> plot(m)
```



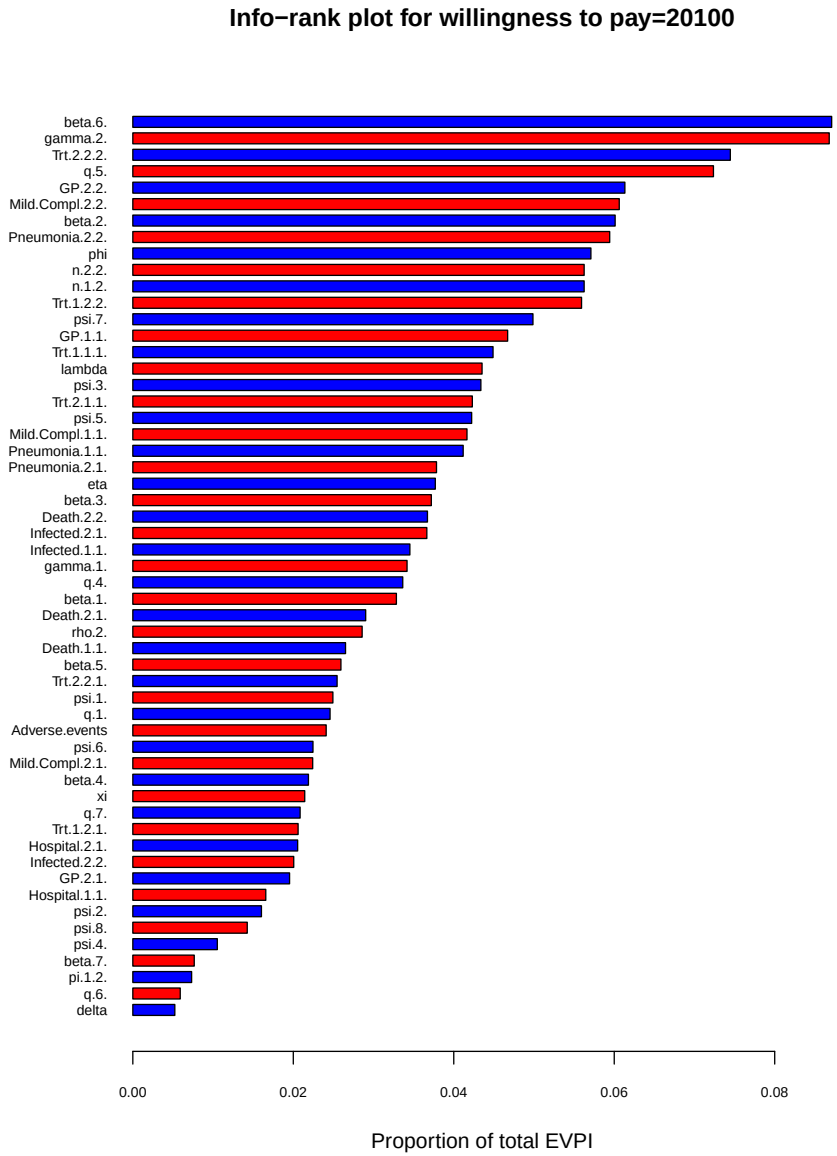
How does BCEA work?

```
# Makes the analysis of the Expected Value of Partial Perfect Information
> x = evppi(c("beta.1.","beta.2."), inp$mat, m)

# Plots the outcome
> plot(x)
```



How does BCEA work?

```
# Summarises uncertainty in the decision making process by means of the "Info Rank" plot
info.rank(inp$parameters,inp$mat,m)
```



A small step towards the "R-HTA-verse"...

https://github.com/giabaio/BCEA/tree/dev

BCEA --- development version

Contents

Overview

Perform Bayesian Cost-Effectiveness Analysis in R. Given the results of a Bayesian model (possibly based on MCMC) in the form of simulations from the posterior distributions of suitable variables of costs and clinical benefits for two or more interventions, produces a health economic evaluation. Compares one of the interventions (the "reference") to the others ("comparators").

Features

Main features of `BCEA` include:

- Summary statistics and tables
- Cost-effectiveness analysis plots, such as CE planes and CEAC
- EVPPI calculations and plots

This is the **development** version of BCEA (currently 2.4). It contains a major refactoring of the code to streamline the functions.

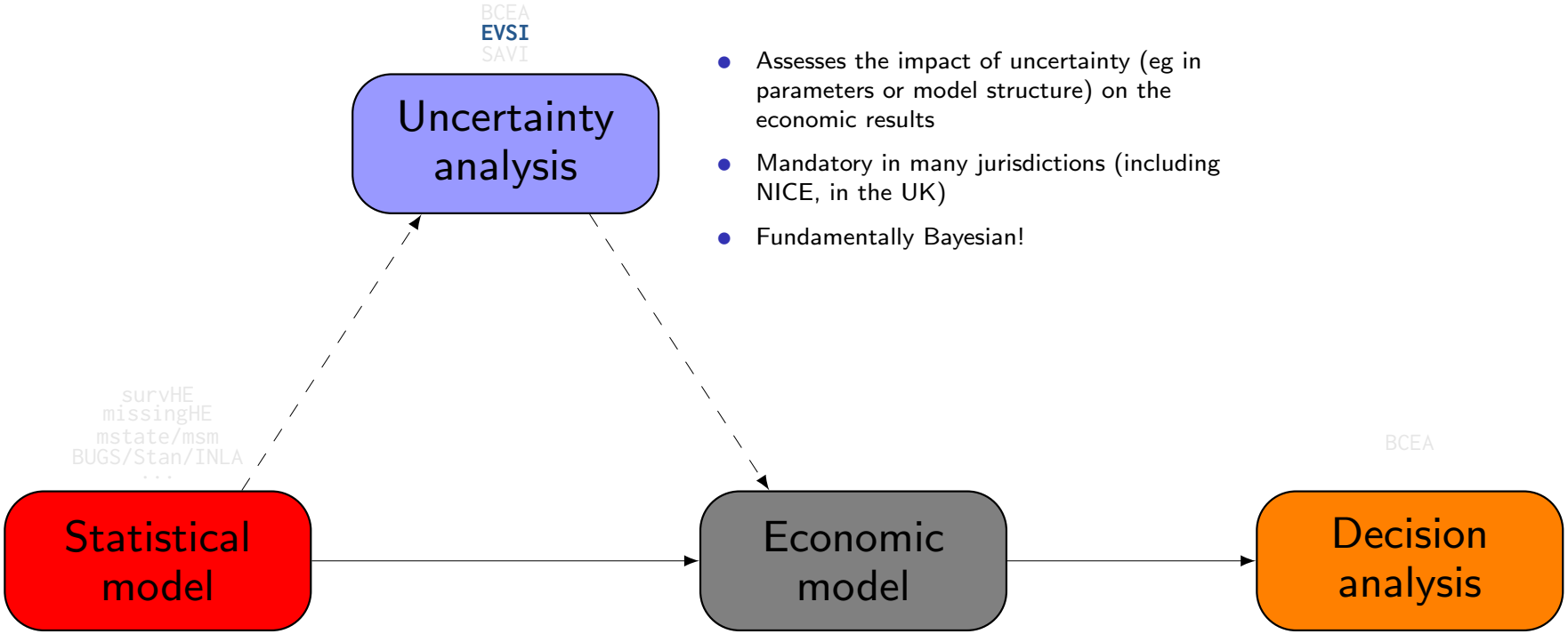
Installation

The development version can be installed using this GitHub repository. On Windows machines, you need to install a few dependencies, including Rtools first, e.g. by running

```
pkgs <- c("MASS", "Rtools", "devtools")
```

Health technology assessment (HTA)

For each module, we may need/use different/specific packages!



- Assesses the impact of uncertainty (eg in parameters or model structure) on the economic results
- Mandatory in many jurisdictions (including NICE, in the UK)
- Fundamentally Bayesian!

- Estimates relevant **population** parameters $\boldsymbol{\theta}$
- Varies with the type of available data (& statistical approach!)

- Combines the parameters to obtain a population average measure for costs and clinical benefits
- Varies with the type of available data & statistical model used

- Summarises the economic model by computing suitable measures of "cost-effectiveness"
- Dictates the best course of actions, given current evidence
- Standardised process

VoI: Basic idea

- A new study will provide new data
  - Reducing (or even eliminating) uncertainty in a subset of model parameters
- Update the cost-effectiveness model
  - If the optimal decision changes, gain in monetary net benefit (NB = utility) from using new optimal treatment
  - If optimal decision unchanged, no gain in NB
- **Expected** VOI is the average gain in NB

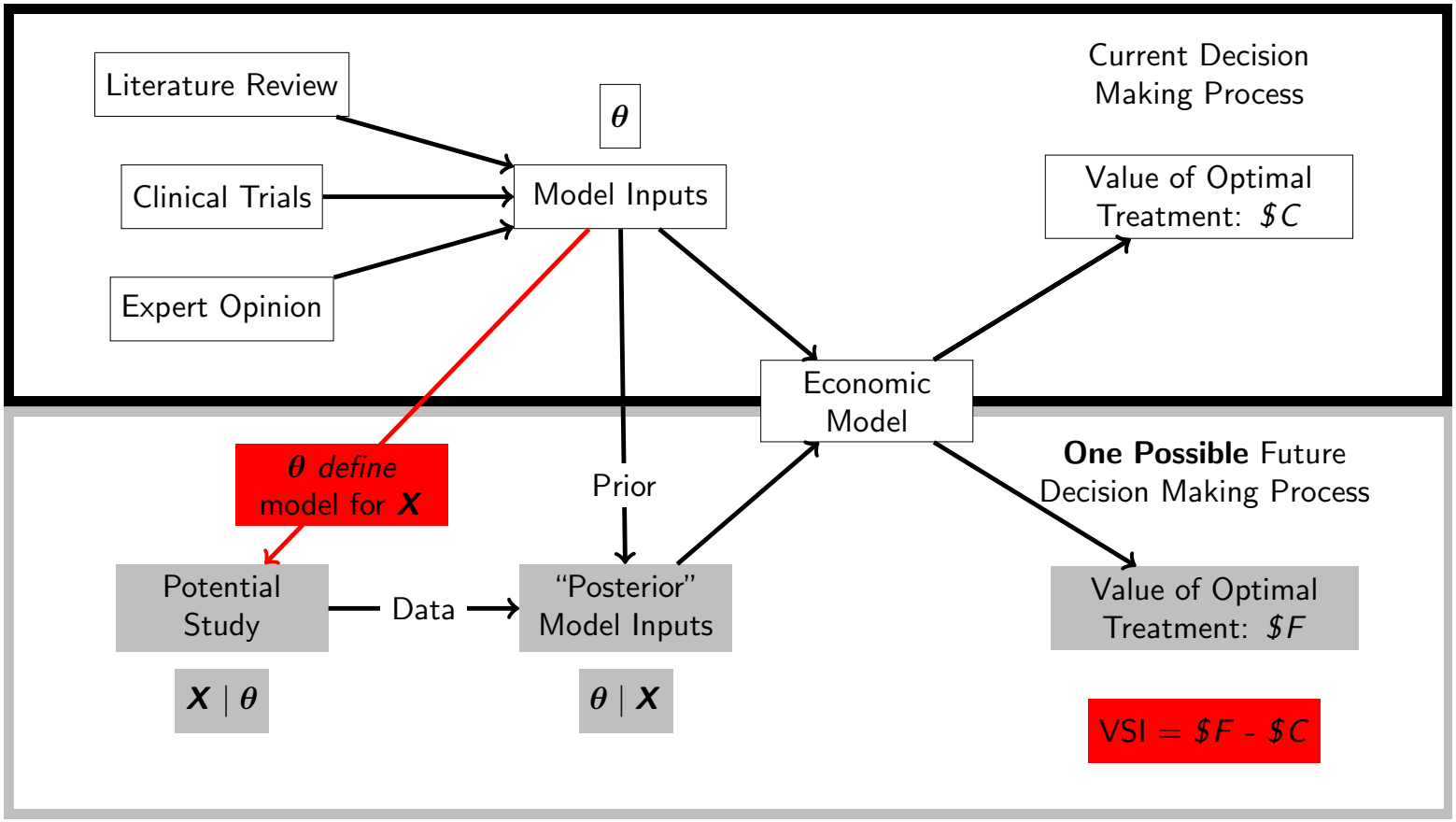
VoI: Basic idea and relevant measures

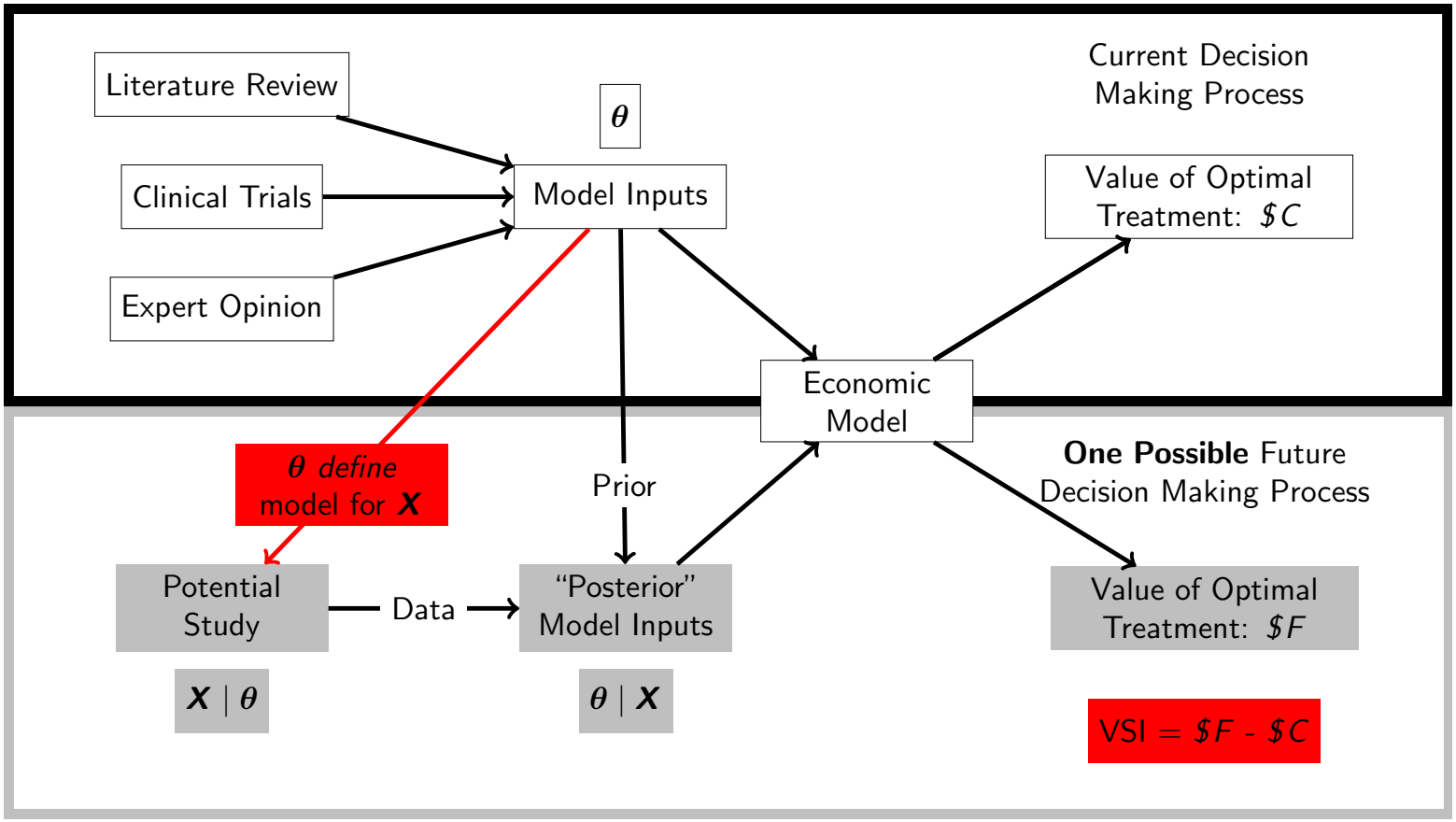
- A new study will provide new data
  - Reducing (or even eliminating) uncertainty in a subset of model parameters
- Update the cost-effectiveness model
  - If the optimal decision changes, gain in monetary net benefit (NB = utility) from using new optimal treatment
  - If optimal decision unchanged, no gain in NB
- **Expected** VOI is the average gain in NB

1. **Expected Value of Perfect Information** (EVPI)
   - Value of completely resolving uncertainty in all input parameters to decision model
   - Infinite-sized long-term follow-up trial measuring everything!
   - Gives an upper-bound on the value of new study — if EVPI is low, suggests we can make our decision based on existing information

2. **Expected Value of Partial Perfect Information** (EVPPI)
   - Value of eliminating uncertainty in subset of input parameters to decision model
   - Infinite-sized trial measuring relative effects on 1-year survival
   - Useful to identify which parameters responsible for decision uncertainty

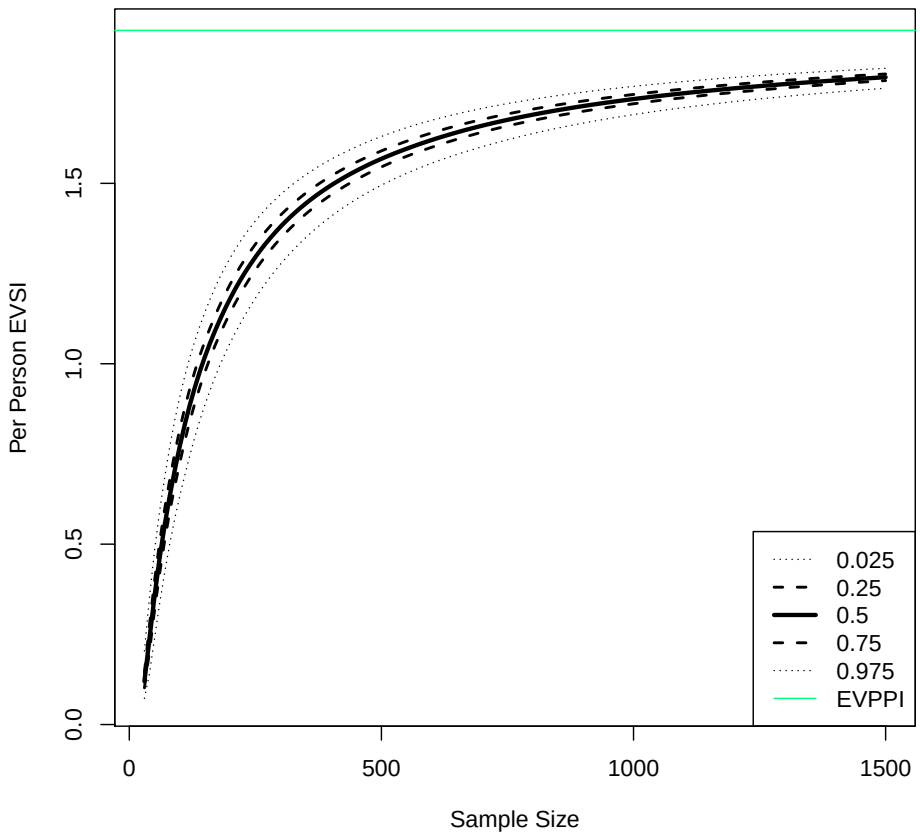
3. **Expected Value of Sample Information** (EVSI)
   - Value of reducing uncertainty by conducting a study of given design
   - Can compare the benefits and costs of a study with given design
   - Is the proposed study likely to be a good use of resources? What is the optimal design?

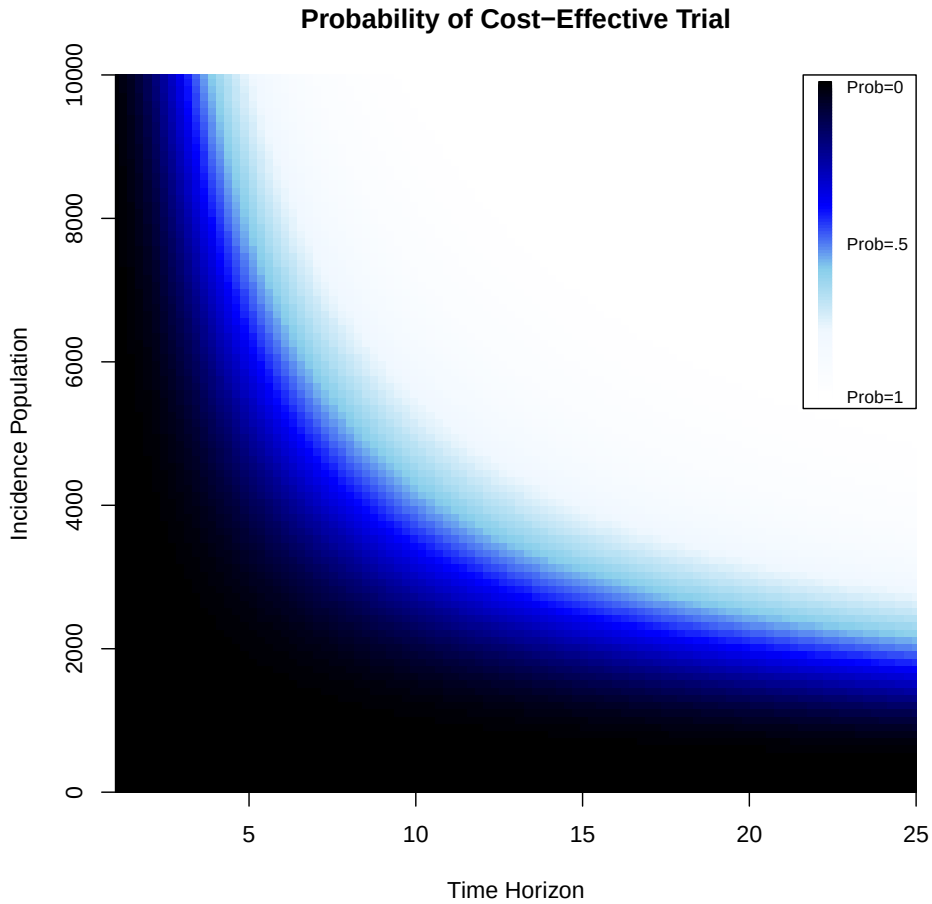

Literature Review
Clinical Trials
Expert Opinion
θ
Model Inputs
Current Decision Making Process
Value of Optimal Treatment: $C
Economic Model
θ define model for X
Prior
One Possible Future Decision Making Process
Potential Study
Data
"Posterior" Model Inputs
Value of Optimal Treatment: $F
$X \mid \theta$
$\theta \mid X$
VSI = $F - $C



- The package `EVSI` can be used (with some knowledge of Bayesian modelling) to estimate the value of effectively any study design in reducing uncertainty in the corresponding decision-making process
  - Sample size calculations/study design
  - Research prioritisation

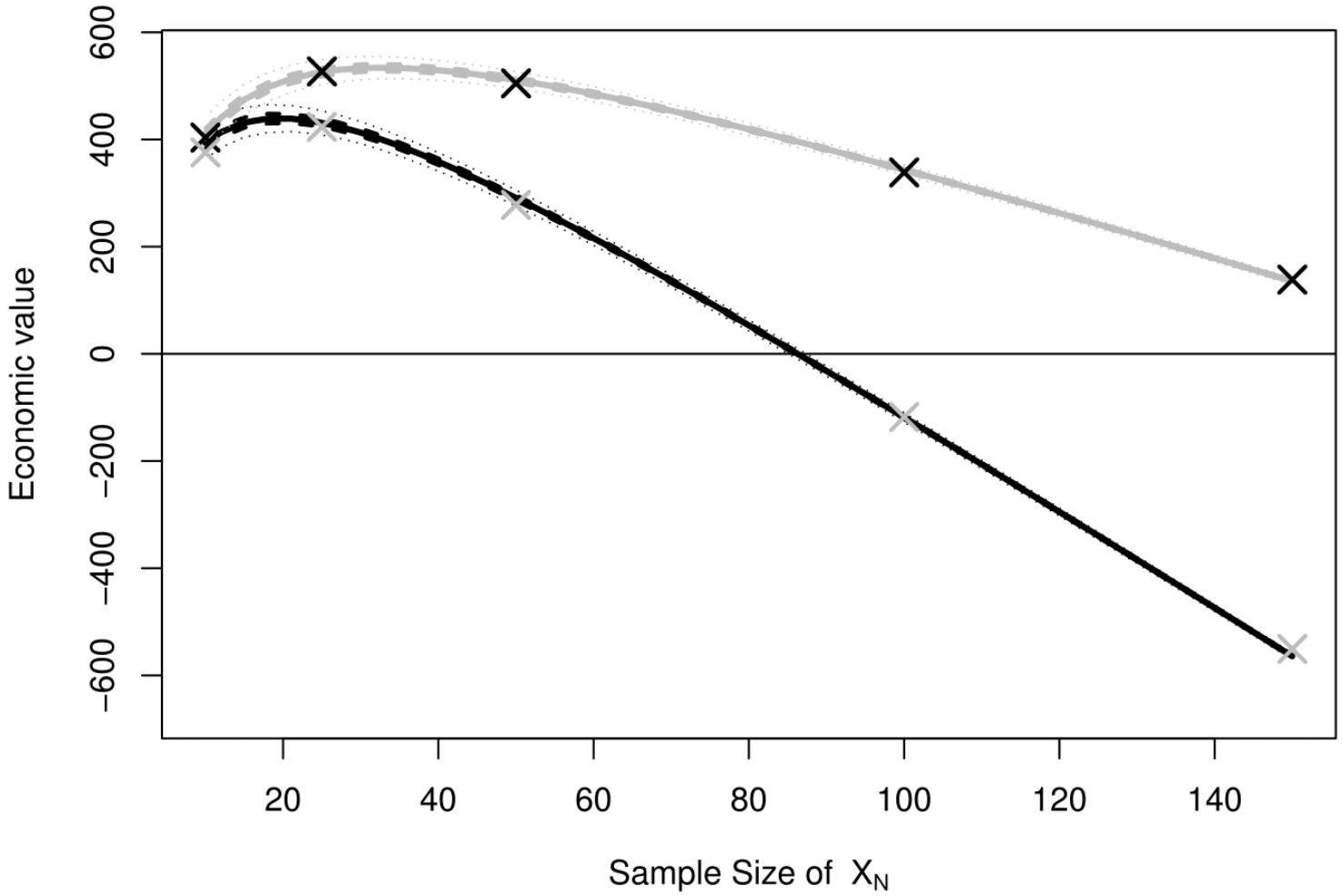
Research priority: Expected Value of **Sample** Information





https://github.com/giabaio/EVSI
https://egon.stats.ucl.ac.uk/projects/EVSI
Heath et al (2018). https://arxiv.org/abs/1804.09590
Heath et al *Medical Decision Making*. 2017. **38(2)**: 163-173

Heath et al *Medical Decision Making*. 2020. Review of EVSI methods. https://doi.org/10.1177/0272989X20912402
Kunst et al *Value in Health*. 2020. Practical recommendations. https://doi.org/10.1016/j.jval.2020.02.010


Economic value
600
400
200
0
−200
−400
−600
20
40
60
80
100
120
140
Sample Size of X_N

Home

Collaborative Network for Value of Information

About us

Our members

Our work

Vol resources

University of Toronto · University of Cambridge · Stanford University · The University Of Sheffield.

University of York · Harvard T.H. Chan School of Public Health · UiO : University of Oslo · CIDE

UCL · University of Pittsburgh · Yale University School of Medicine · SickKids

UEA University of East Anglia · University of Bristol · Decision Modeling Center VUMC · uOttawa

All in!

The University Of Sheffield.

SAVI - Sheffield Accelerated Value of Information

Funded by NIHR

Release version 2.0.10 (2015-09-24)

Home | About your model | Import files | Check upload | PSA Results | EVPI | EVPPI single parameters | EVPPI groups | Report | About us

What SAVI does

Using **only** PSA results from your model

In a matter of seconds from the SAVI online application you can generate:

1. Standardised assessment of uncertainty (C-E planes and CEACs)
2. Overall EVPI per patient, per jurisdiction per year and over your decision relevance horizon
3. Expected Value of Perfect Parameter Information (EVPPI) for single and groups of parameters

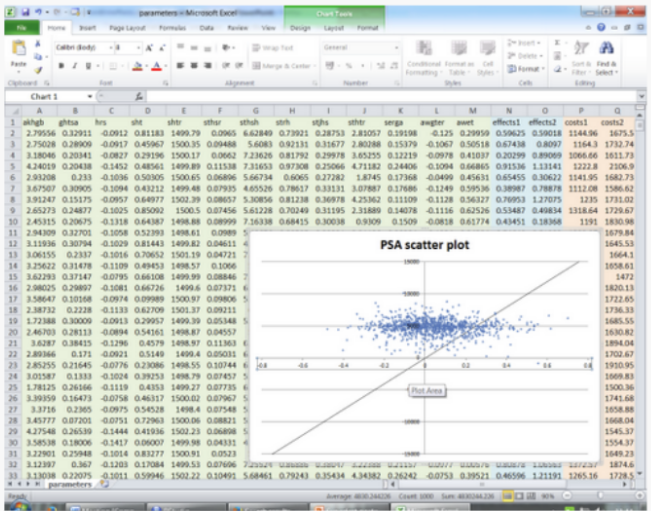
For individual-level simulation models you only need to simulate a small number of individuals per PSA sample. See the "About your model" tab.

Disclaimer: This application is based on peer-reviewed statistical approximation methods. It comes with no warranty and should be utilised at the user's own risk (see here). The underlying code is made available under the BSD 3-clause license.

For more information on the method see Mark Strong's website or this paper.

The SAVI process has 4 steps (using the TABS from left to right)

Step 1: Save PSA input parametes, costs and effects as separate .csv files



Sign up for SAVI news and updates

Send a blank email to savi@sheffield.ac.uk

We won't share your email address with anyone.

Also, you can now follow SAVI on Twitter. The SAVI team tweet regular updates and new features.

Follow @SheffieldSAVI

News

SAVI is now available as an R package, allowing you to run SAVI directly on your own machine. You can download instructions here.

Known issues

Sometimes SAVI will either not load, or will hang for a while. This is because SAVI can only deal with one set of computations at a time, even though SAVI allows multiple concurrent users. Be assurred that SAVI keeps concurrent users' data and results separate.

The "Save session" and "Load previously saved session" facilities are temporarily out of action due to problems of backward compatibility with SAVI version 1.

The report that SAVI generates is not quite as polished as we would like. We are working on this.

New features and bug fixes

Fix for version 2.0.9

We have added a note on the EVPPI Groups tab to say that the GP method for calculating partial EVPI for groups of five or more parameters uses only the first 7,500 rows of the PSA.

BCEAweb

Welcome | 1. Check assumptions | 2. Economic analysis | 3. Probabilistic Sensitivity Analysis | 4. Value of information | 5. Report

In this panel, the user can upload the simulation data for the economic output. These are defined in terms of a vector of simulations for the effectiveness variable and a vector of simulations for the cost variable, for each of the interventions being assessed.

The user can also specify the range and default value for the willingness-to-pay parameter, as well as the labels associated with each interventions. Clicking the `Run analysis` button will run BCEA in the background to perform the economic analysis.

In this panel, the user can upload the (e,c) data for the relevant model parameters.

1. Import the (e,c) data from:

Spreadsheet

Choose .CSV File

Browse... effects_costs_3d_for_BCEAweb.csv

Upload complete

2. Define the grid of values for the willingness to pay (wtp)

min	max	step
0	50000	100

3. Define value for the wtp threshold (eg £)

10000

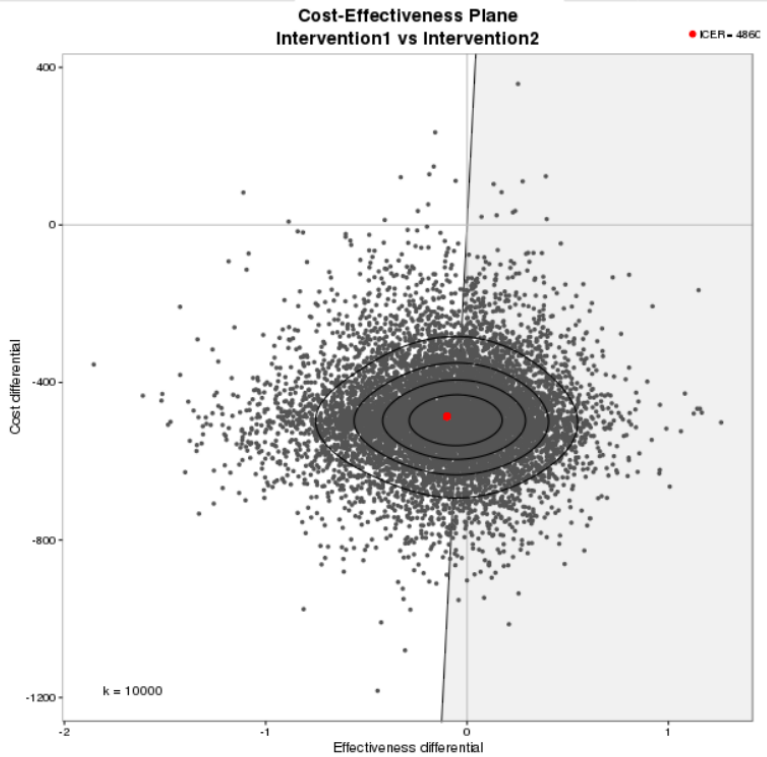
4. Define intervention labels

Intervention1

Intervention2

Intervention3

2.1. Cost-Effectiveness Analysis | 2.2. Cost-Effectiveness plane | 2.3 Expected Incremental Benefit | 2.4 Cost-Effectiveness Efficiency Frontier



Select comparison to plot

Intervention1 vs Intervention2

All

Intervention1 vs Intervention2

Intervention1 vs Intervention3

Let's go all the way?...

https://egon.stats.ucl.ac.uk/projects/MMweb/

1. Introduction | 2. Parameter input | 3. Cohort simulation | 4. Health economic evaluation | 5. Value of information

The parameters of the base-case scenario can be displayed without running the model.

Show base-case

After completing the selection of the inputs, click the button to run the statistical analysis

Run MCMC

MCMC simulations: 50

Population parameters | Survival analysis | Administration costs | Treatment costs | Adverse events | Utilities

Population indolent non-Hodgkin's lymphoma (source)

13518

% rituximab refractory follicular lymphoma

Mean (source): 9 SD (assumption): 0.01

Mean age (source)

62.07

Weight in kg

Mean (source): 81 SD (assumption): 10

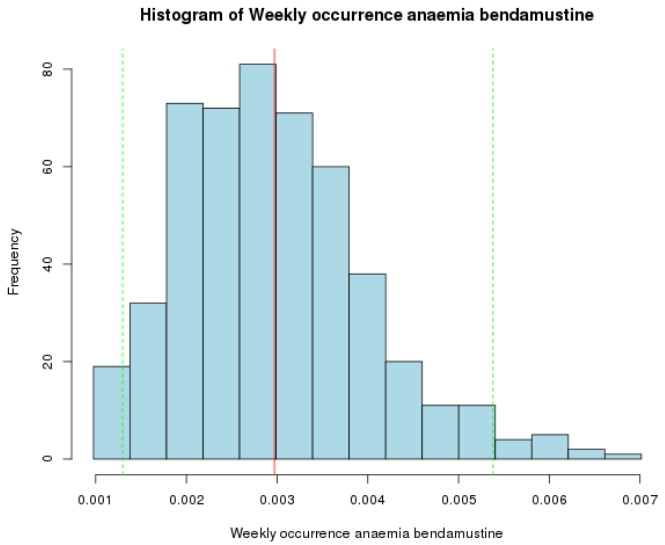
Height in cm

Mean (source): 169.52 SD (assumption): 10

2.1 Check assumptions | 2.2 Trace plots | 2.3 GR plots | 2.4 Effective sample size | 2.5 Autocorrelation

Parameter of interest: Weekly occurrence anaemia bendamustine

Select the number of BINs for histogram: 15



Mean	Standard deviation	2.5%	Median	97.5%	Monte Carlo SE
0.0029703	0.0010262	0.0012969	0.0028678	0.0053797	0.0004194

Escape (from Excel) to victory