Some analysis of the CAFE CBA

ExternE workshop 11-12 May Paris

Lourens Post, AQ Technical Coordinator

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Contents

1. Comparison of Newext VOLY with other studies

2. Statistical uncertainty analysis CAFE CBA results

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Estimating the VOLY value

- For air pollution context VOLY is the relevant metric, VSL is not
- Studies trying to elicit VOLY directly are preferred, but they are few and far between

1. Johannesson, M., Johansson, P-O., 1996, *To Be, or Not to Be, That Is the Question: An Empirical Study of the WTP for an Increased Life Expectancy at an Advanced Age*, J. of Risk and Uncertainty, volume 13, pp. 163-174, 1996.
2. Morris, J., Hammitt, J.K., 2001, *Using Life Expectancy to Communicate Benefits of Health Care Programs in Contingent Valuation Studies*, Medical Decision Making, Nov-Dec 2001, pp. 468-478, 2001.
3. Chilton, S., Covey, J., Jones-Lee, M., Loomes, G., Metcalf, H., 2004, *Valuation of health benefits associated with reductions in air pollution*', Defra publication PB 9413, May 2004.

- All stated preference (Contingent Valuation)

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Backup

Johannesson & Johansson

- Swedish citizens
- Life expectancy increase of 1 year (10 → 11 years) at age 75 due to medical treatment, conditional on having survived until the age of 75
- Only one (random) WTP offered: yes/no
- 71% of the answers is 'No'
- Average WTP (VOLY) is $ 400 to $ 1500 depending on statistical estimation technique used

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Backup

Morris & Hammitt

- US citizens, all younger than 60 or 70 resp.
- Methodology:
  - Half of the respondents were asked for WTP for a vaccine; benefit expressed as a life expectancy gain (LE)
  - For the other half the equivalent benefit was expressed as a reduction in the average annual chance of death (RR)
  - Each half was further split (in total 4 subsamples): two samples were asked to give WTP if the vaccine was given at age 60, the other two samples for a vaccine given at age 70
  - Double-bounded dichotomous
- Response rate 75%, of those 30% would not consider getting the vaccine
- LE method has greater validity than RR method (scope test)
- LE also higher values than RR
- VOLY between <u>$ 492 and $ 698</u>

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Chilton et al. ('Defra')

- UK citizens
- Extensive study, well thought out methodology:
  - Three subsamples: 1, 3 or 6 months extra life
  - All respondents (1/3/6 extra months): in Normal Health & Poor Health
  - All respondents: Avoiding hospital admissions & Avoiding breathing discomfort
- Using card ranking method
- Total of 665 respondents (55% response rate); 10 refusals, 138 protest zeros (all ignored), 46 non-protest zeros (included)
- VOLY values found:

Based on:	1 month N	1 month P	3 months N	3 months P	6 months N	6 months N
Mean	€ 45,298	€ 12,421	€ 22,771	€ 5,693	€ 12,705	€ 2,168
Median	€ 15,360	€ 1,783	€ 2,218	€ 0	€ 2,663	€ 395

- 'Pick your own'
- Choice for 1-month based VOLY is not well justified

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General issues

- Low response rates
- Significant amounts of ‘protest’ zeros: always ignored
- The median is a much more robust estimator than the mean
- Using the full probability distribution is an even better approach
  - Here full data set used (apart from J&J)
  - Weibull distribution assumed and data fitted accordingly

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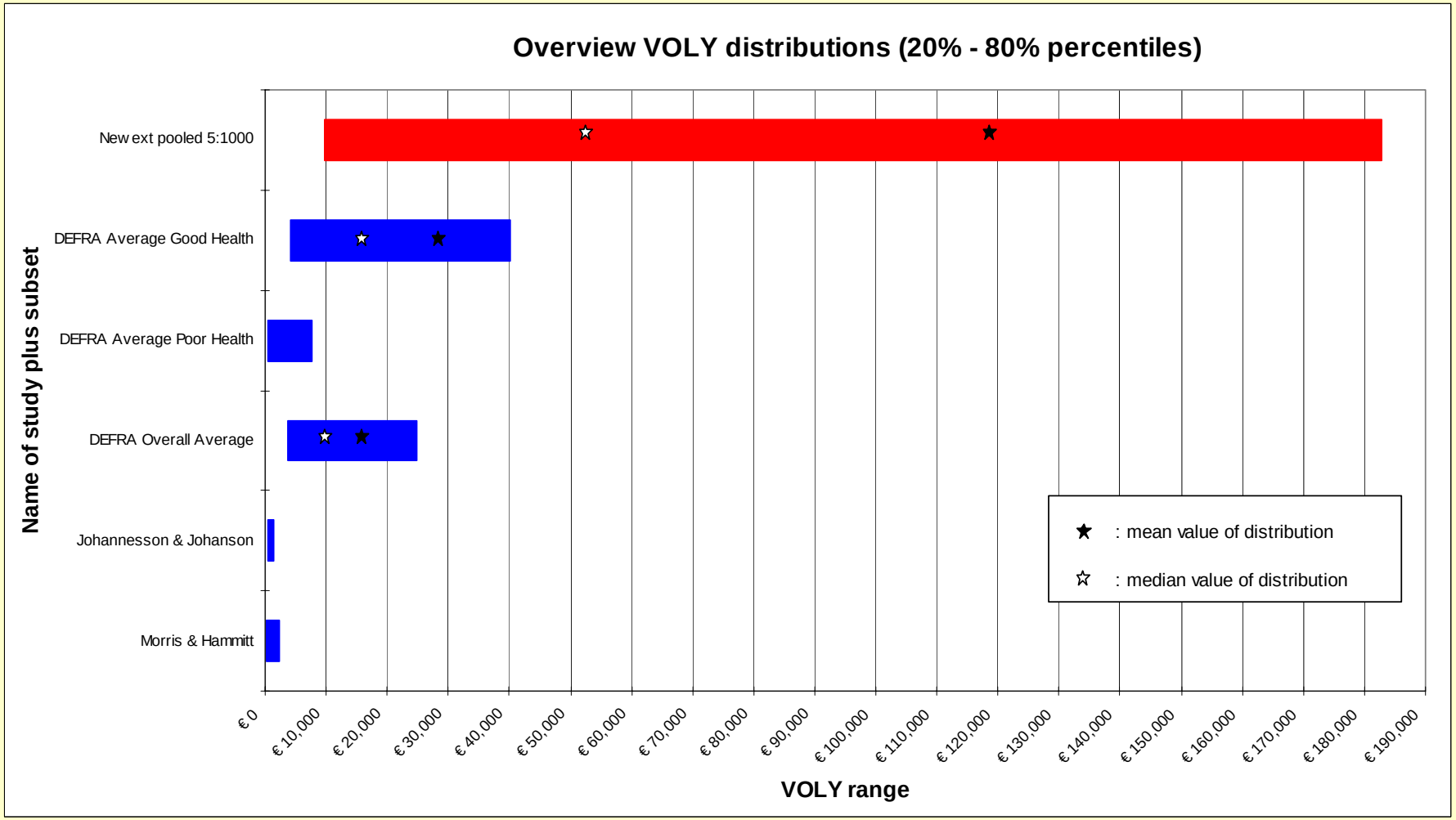
Range of stated preference WTP VOLY studies



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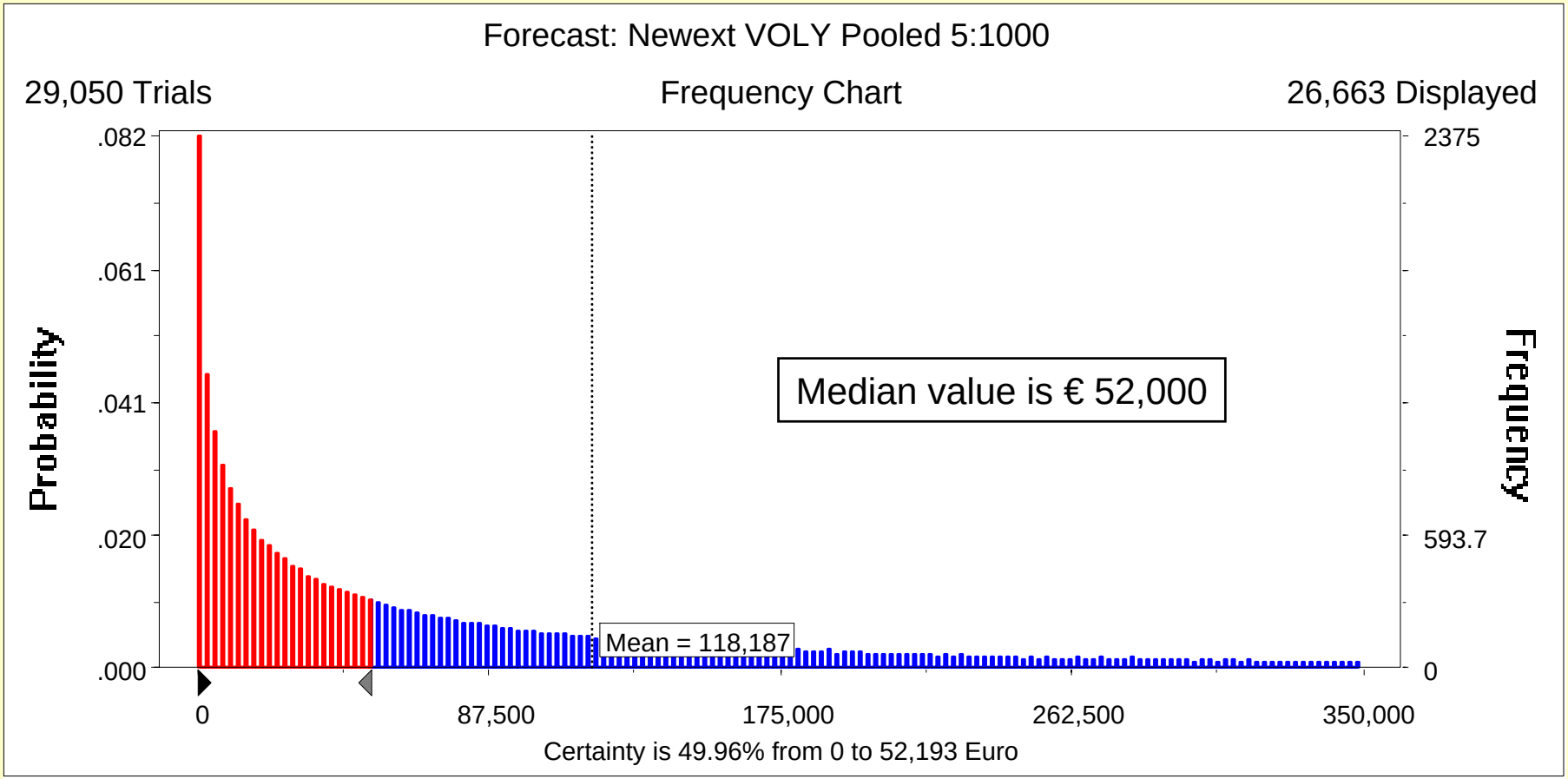
Newext VOLY distribution (pooled 5:1000, 2004)



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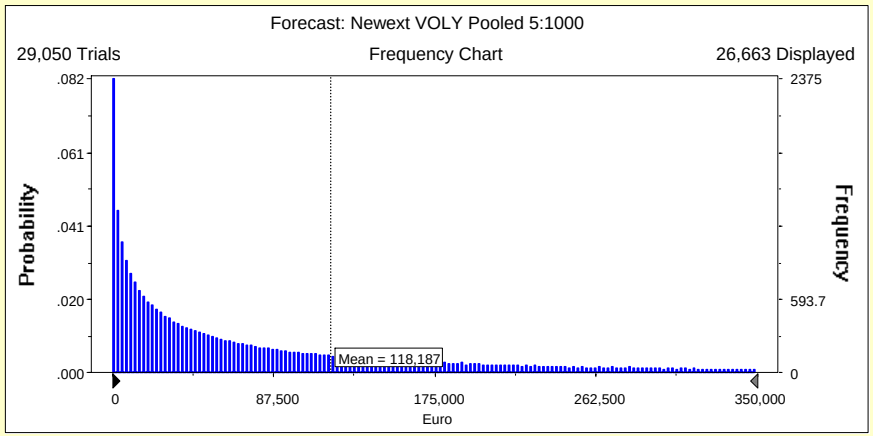
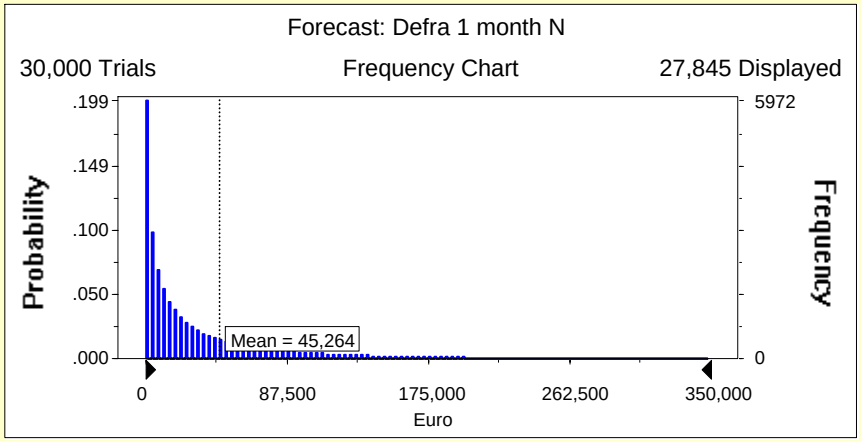
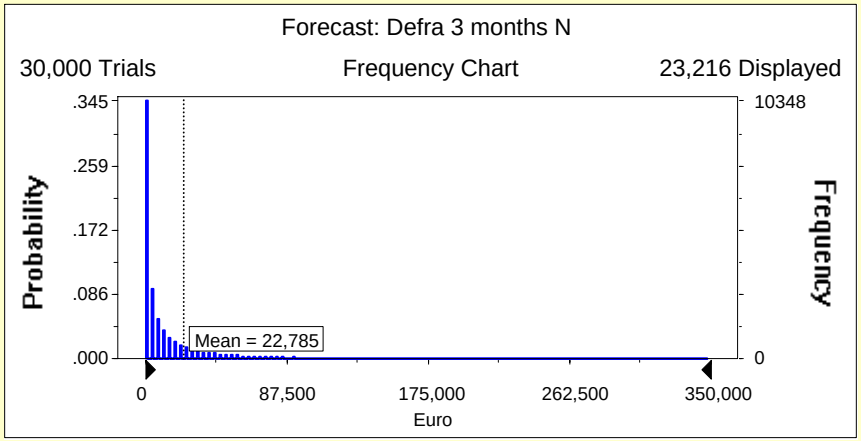
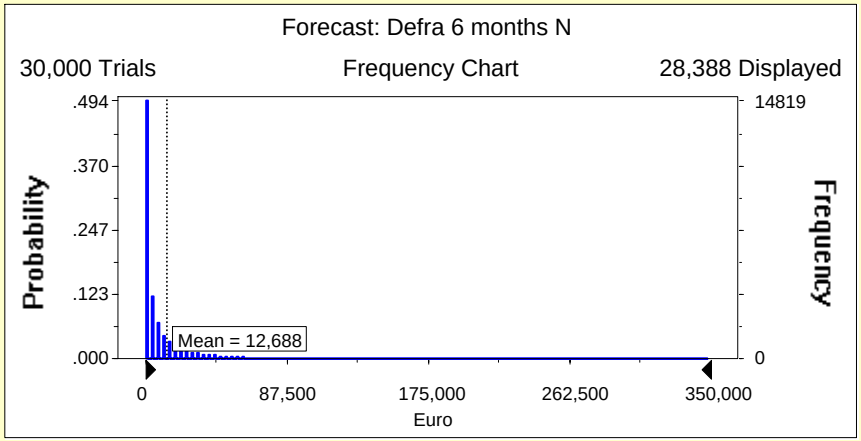
Newext and Defra Normal Health









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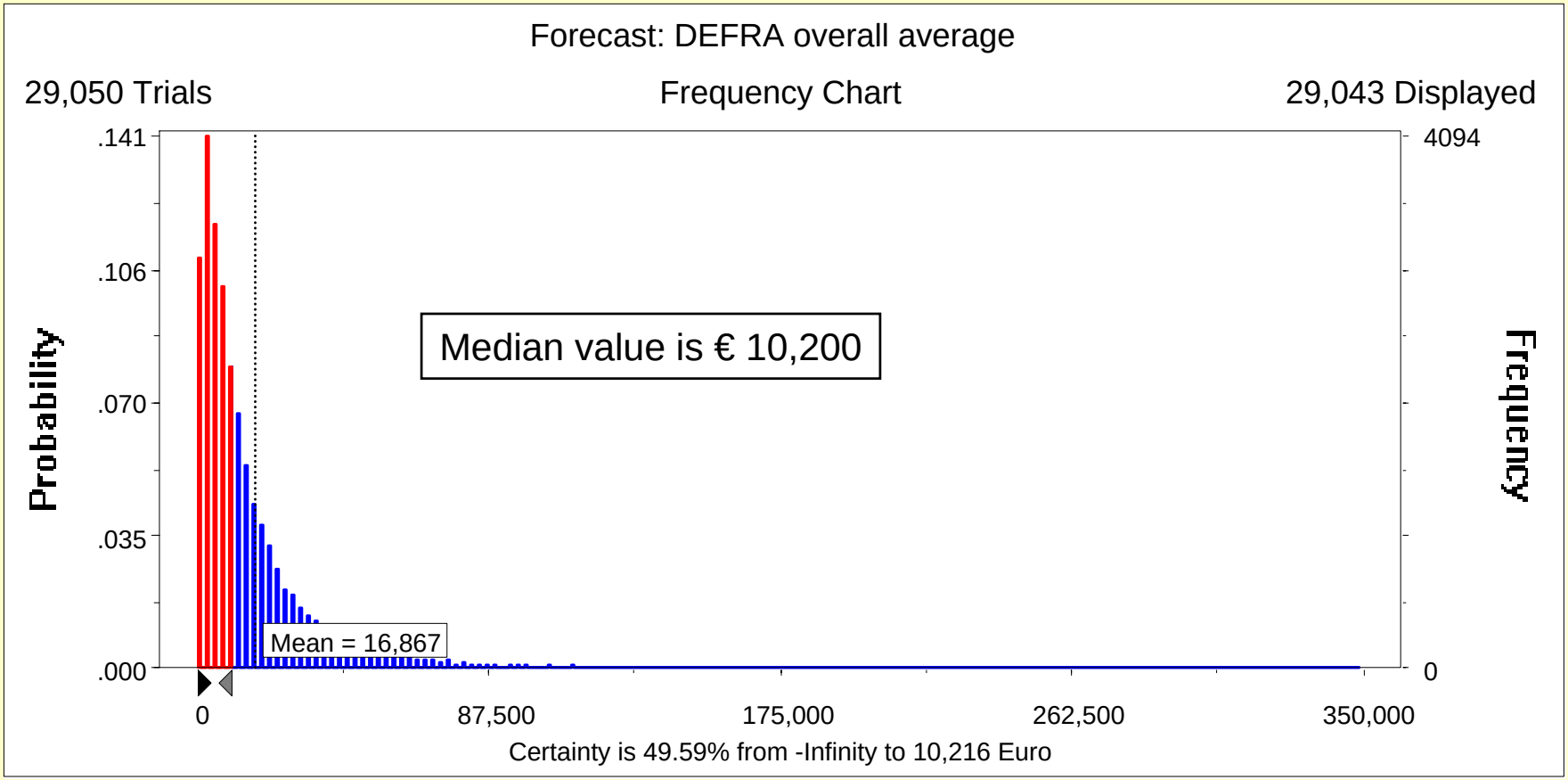
Alternative VOLY distribution: Defra overall average



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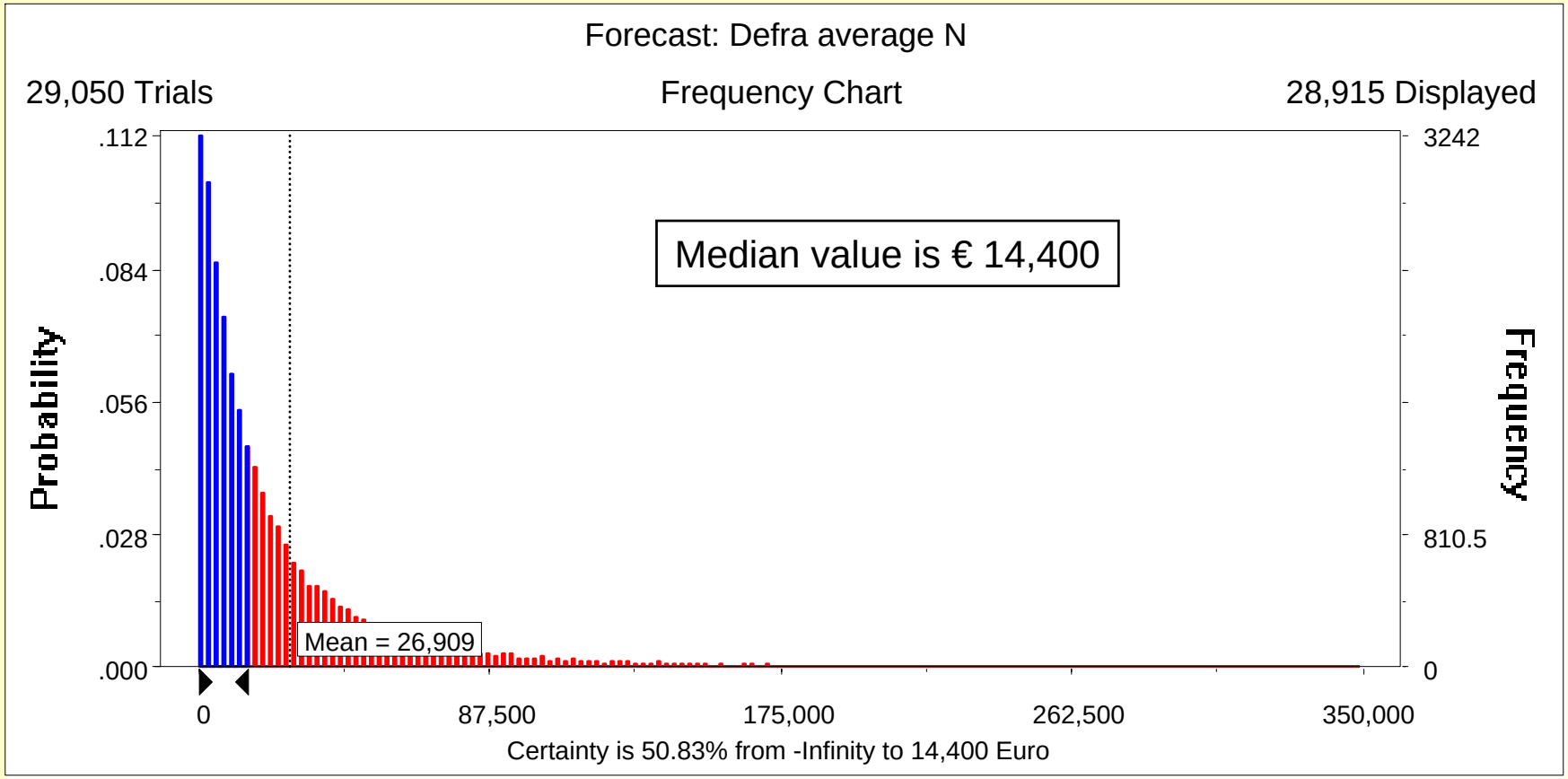
Alternative VOLY distribution: Defra average Normal



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Backup

Caution of Newext team itself

Quotes from *the* source for the Newext study (Alberini, Hunt, Markandya, September 2004), underline by us.

"We are aware of only two other studies that have employed stated preference techniques for placing a value on life expectancy gains, Johannesson and Johansson (1996) and Morris and Hammitt (2000)."

"These studies are not directly comparable to ours, but, even accounting for the futurity of the risk reduction or life expectancy extension, they seem to imply much lower WTP figures than those produced by our study."

"Our results give some new answers to the research questions we have posed. Future research will need to confirm these findings before our conclusions can become established in policy appraisal."

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Assumptions CAFE CBA statistical uncertainty analysis

- Full Weibull distributions for VOLY. Default is Newext
  - Variation Chilton et al. (Defra)

- CAFE CBA: 0.6% all cause mortality per 1 $\mu g/m^3$ $PM_{2.5}$
  - Variation: 0.2% as per Krewski at al. 2000 (PM mortality adjusted for SO_2 effects)
  - Variation: 0.4% as per Pope et al. 2002 (considering long time lag for PM effects as per the WHO Global Burden of Disease Study)

- Morbidity as in CAFE CBA
  - Variation: no morbidity (as in CAFE CBA before peer review)

- Annualised costs from RAINS with distribution
  - Normal distribution assumed
  - Standard deviation is taken as 20% of the mean $\mu \Rightarrow$ 99% confidence interval is $[0.5 \cdot \mu, 1.5 \cdot \mu]$

- Relevant metric is <u>Marginal Benefits minus Marginal Costs</u>

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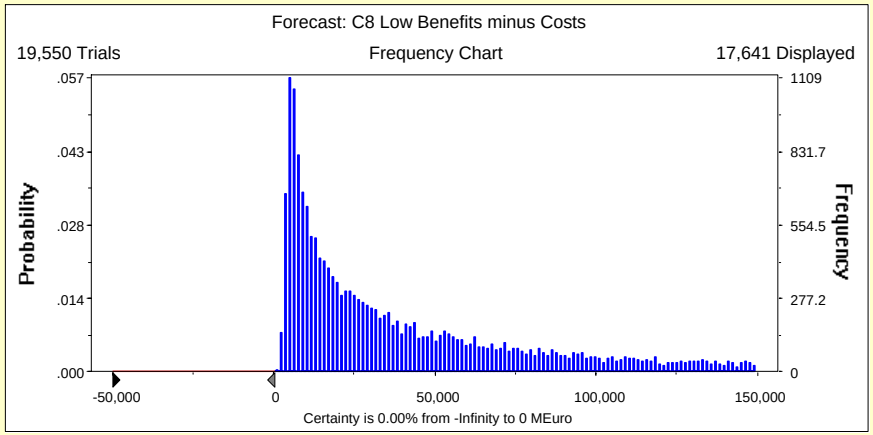
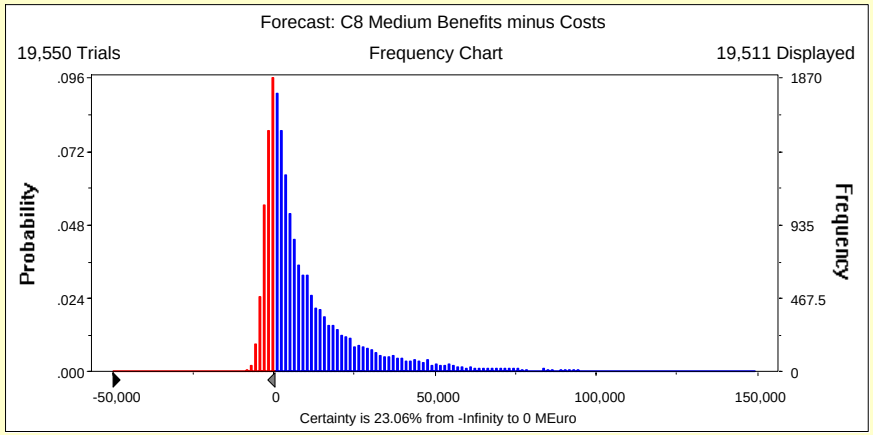
Scenario C8 *Joint Optimisation*

Marginal Benefits minus Marginal Costs; Newext VOLY distribution

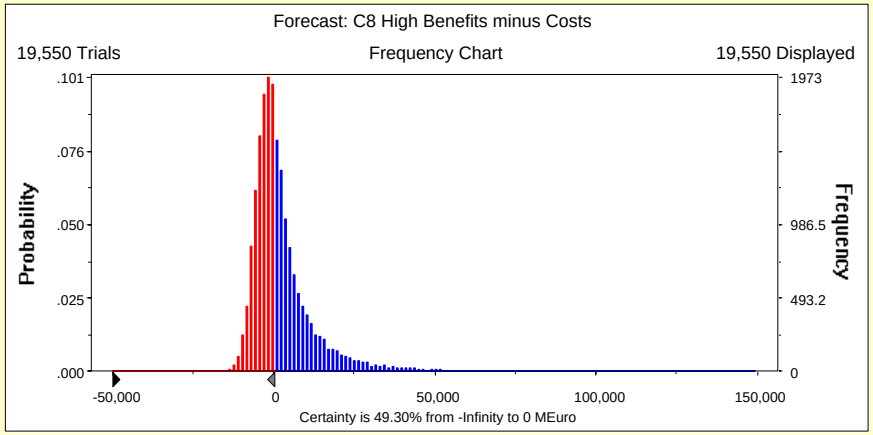
C8 Low; 0% chance of regrets



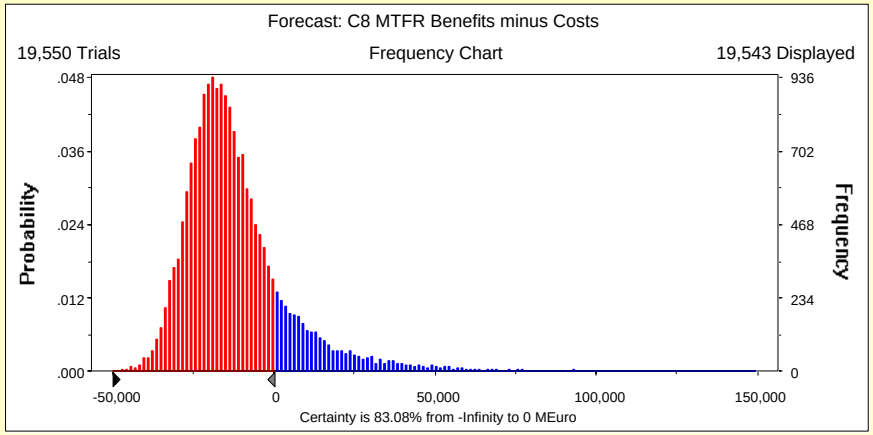
C8 Medium; 23% chance of regrets



C8 High; 49% chance of regrets



C8 MTFR; 83% chance of regrets



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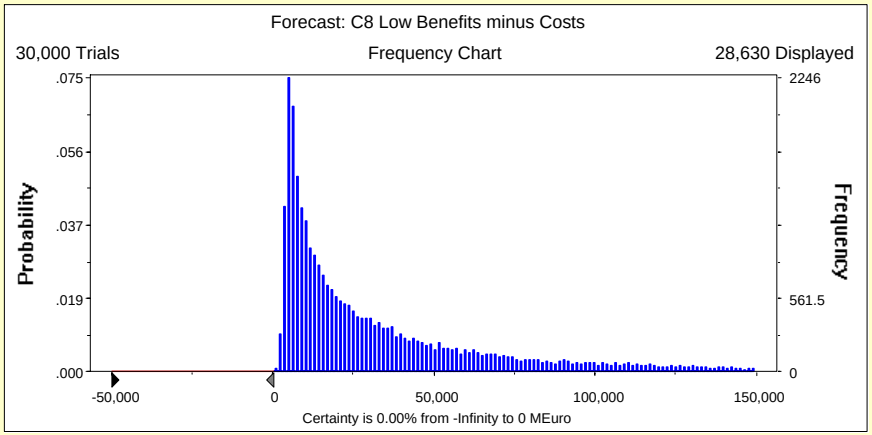
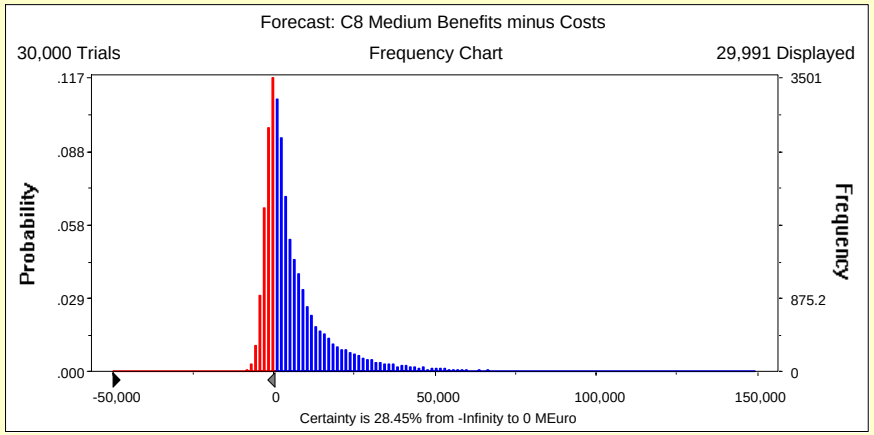
Scenario C8 *Joint Optimisation*

Marginal Benefits minus Marginal Costs; Newext; PM mort. 0.4% slope

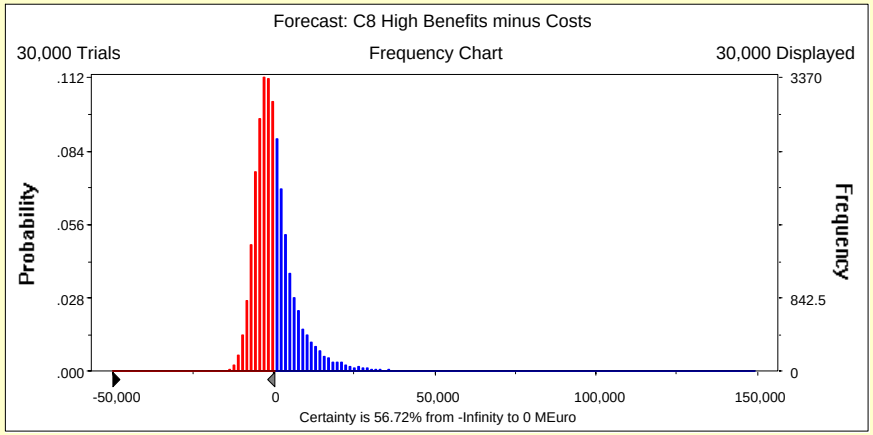
C8 Low; 0% chance of regrets



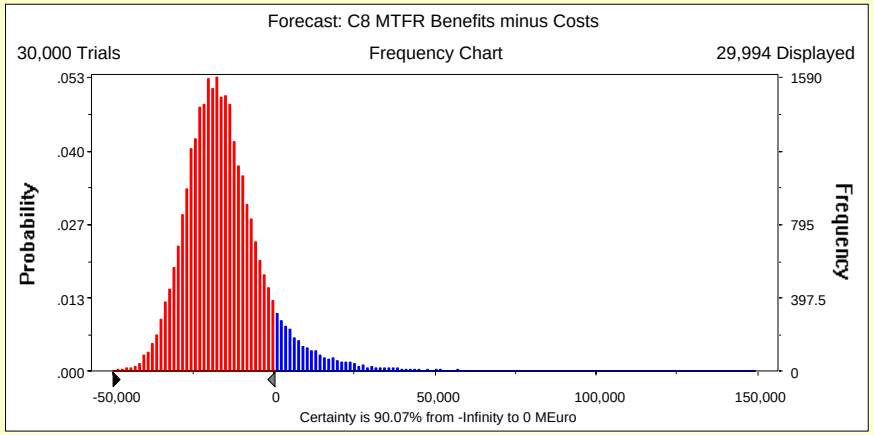
C8 Medium; 29% chance of regrets



C8 High; 57% chance of regrets



C6 MTFR; 90% chance of regrets



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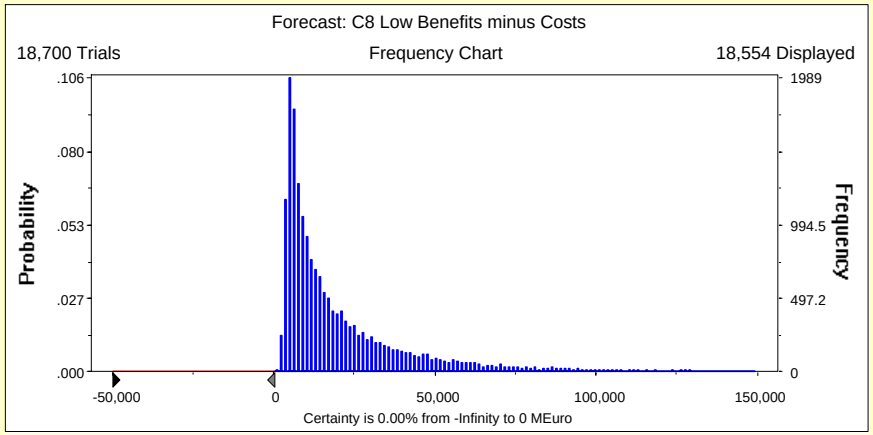
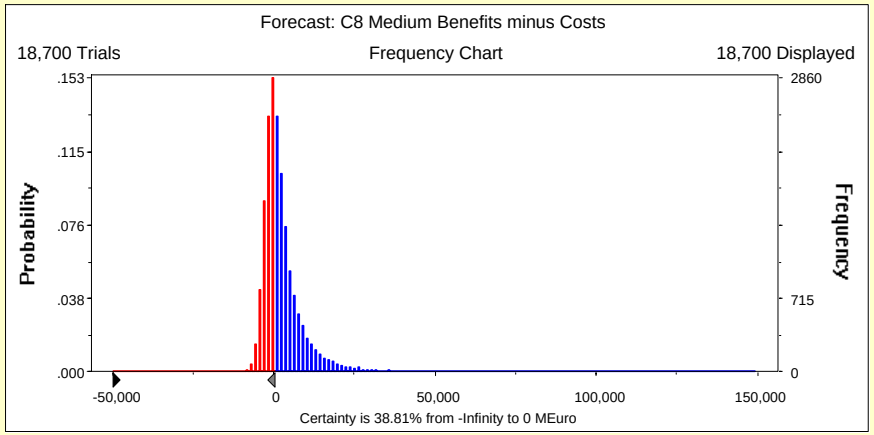
Scenario C8 *Joint Optimisation*
Marginal Benefits minus Marginal Costs; Newext; PM mort. 0.2% slope

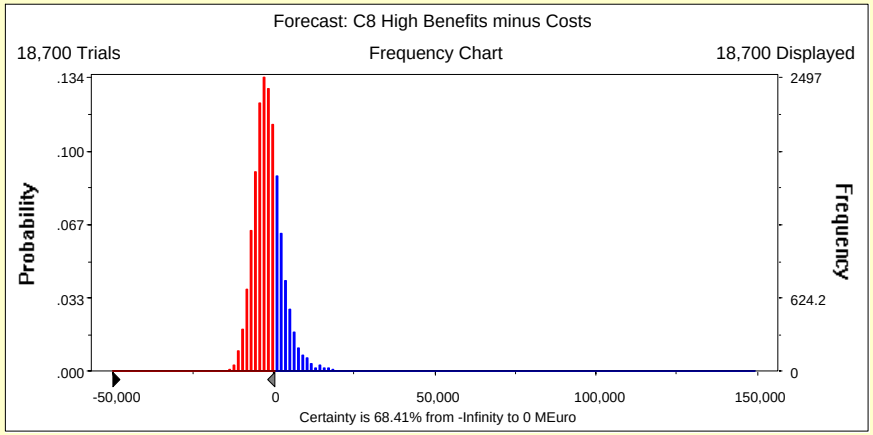
C8 Low; 0% chance of regrets



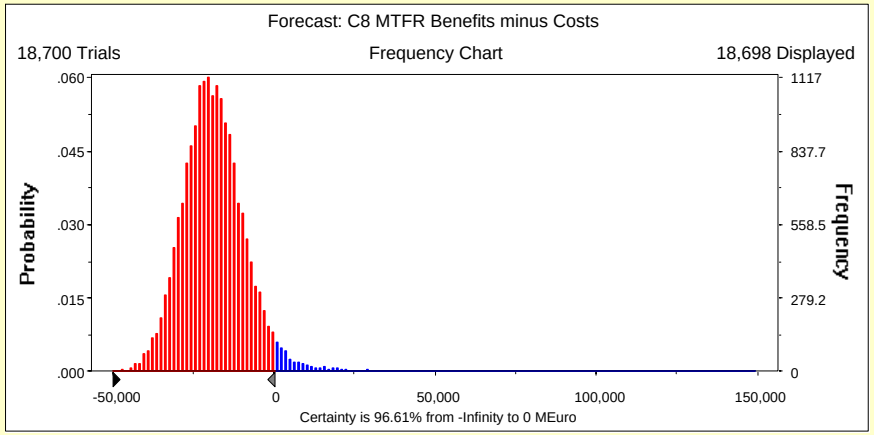
C8 Medium; 39% chance of regrets



C8 High; 68% chance of regrets



C8 MTFR; 97% chance of regrets



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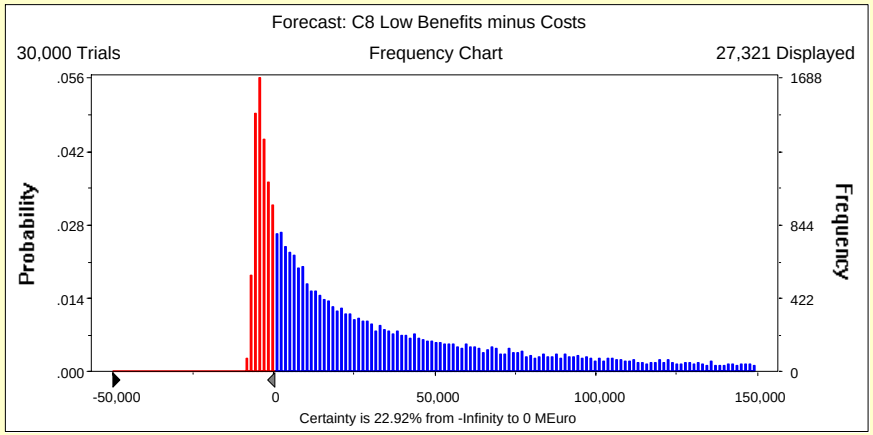
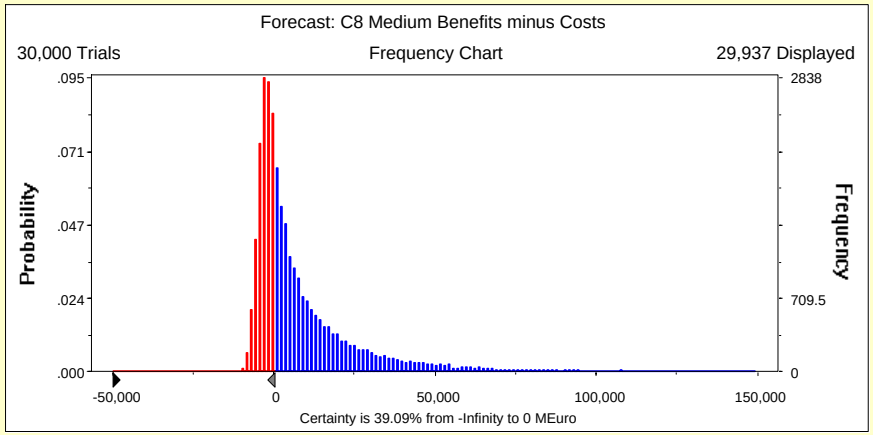
Scenario C8 *Joint Optimisation*

Marginal Benefits minus Marginal Costs; Newext; no morbidity

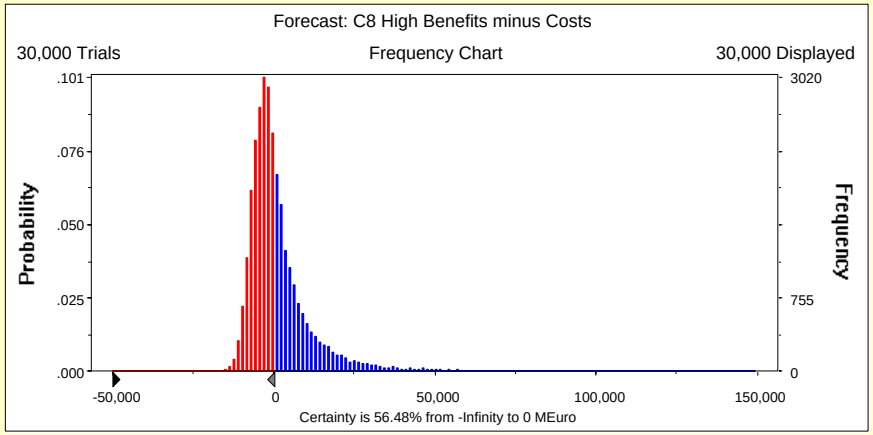
C8 Low; 23% chance of regrets



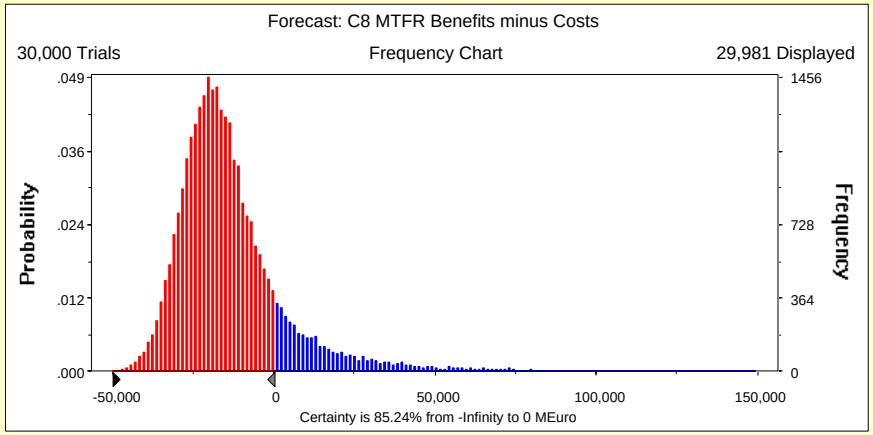
C8 Medium; 39% chance of regrets



C8 High; 56% chance of regrets



C8 MTFR; 85% chance of regrets



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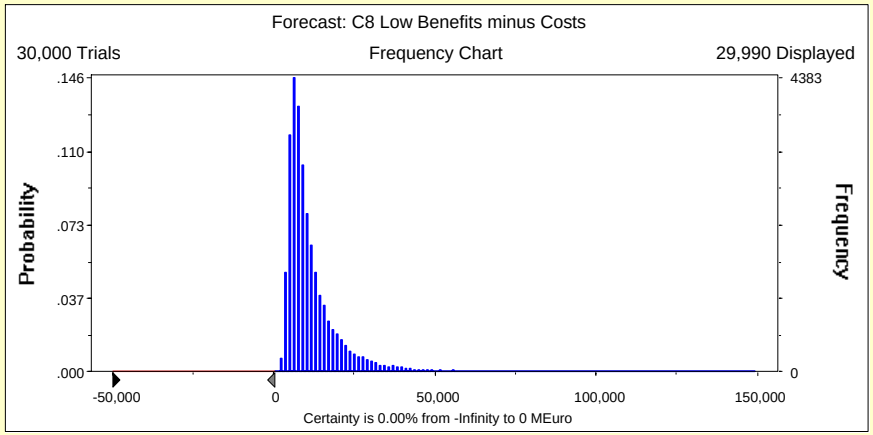
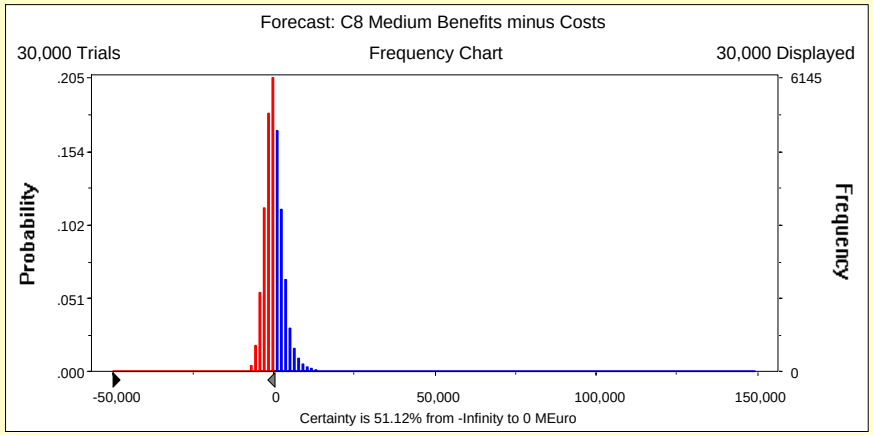
Scenario C8 *Joint Optimisation*

Marginal Benefits minus Marginal Costs; Defra overall average VOLY

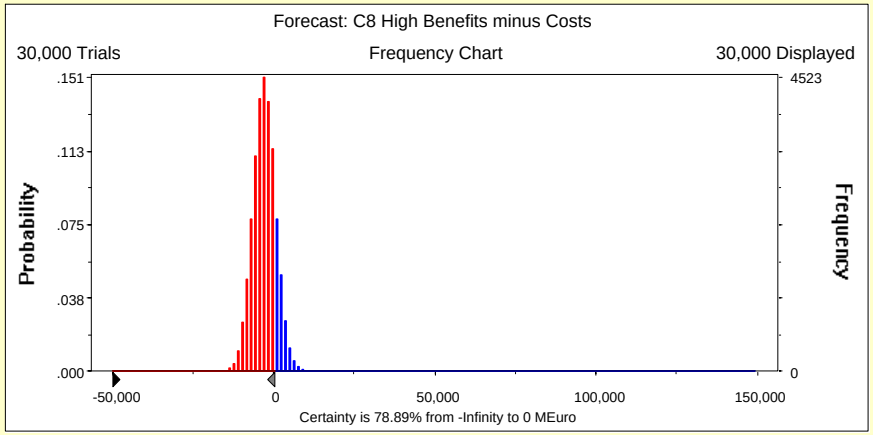
C8 Low; 0% chance of regrets



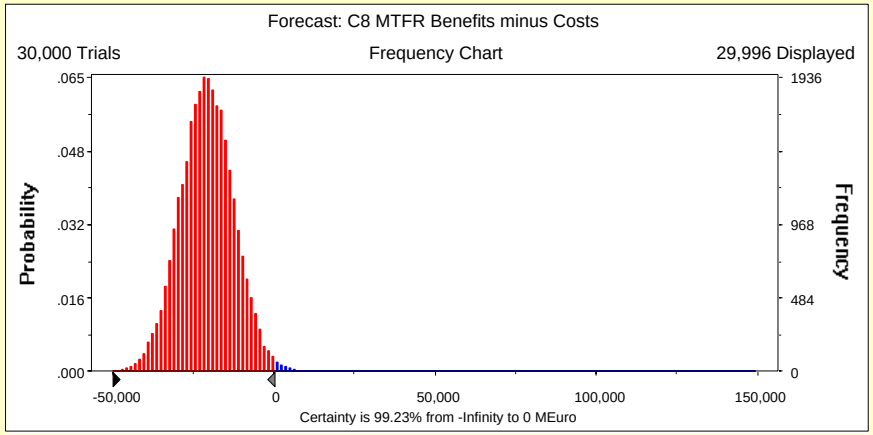
C8 Medium; 51% chance of regrets



C8 High; 79% chance of regrets



C8 MTFR; 99% chance of regrets



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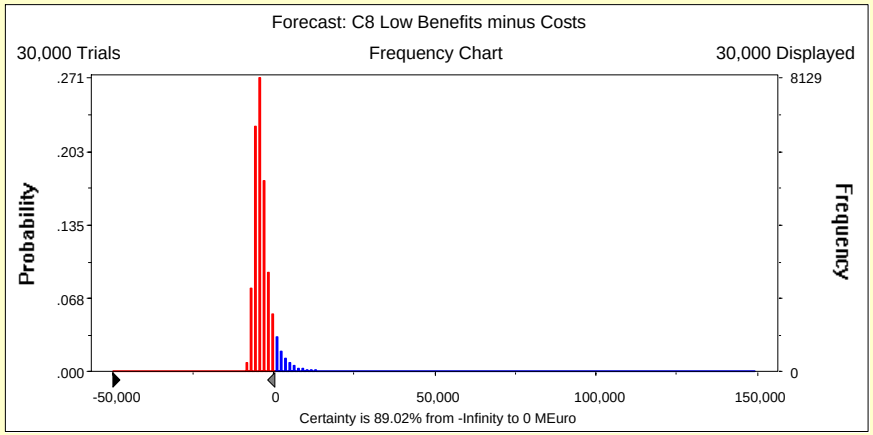
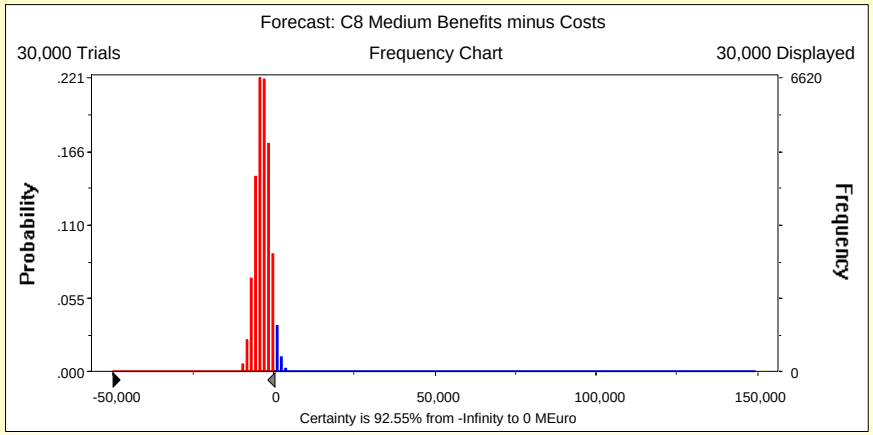
Scenario C8 *Joint Optimisation*

Marginal Benefits minus Marginal Costs; Defra overall average; 0.2% slope; no morbidity

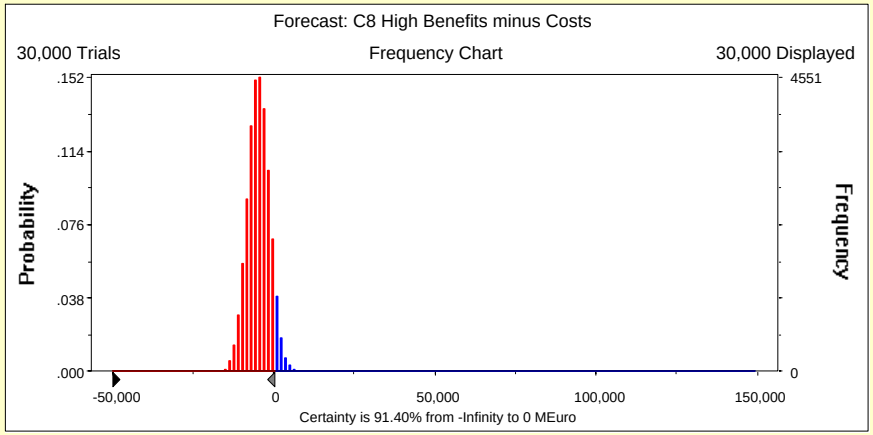
C8 Low; 89% chance of regrets



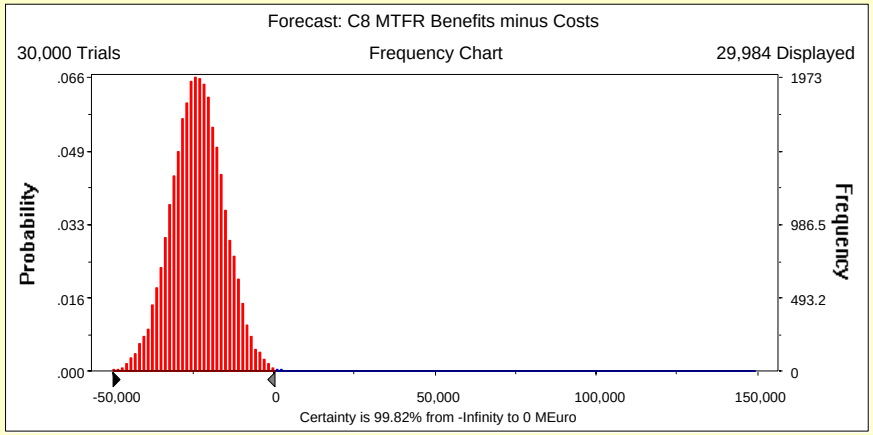
C8 Medium; 93% chance of regrets



C8 High; 91% chance of regrets



C8 MTFR; 100% chance of regrets



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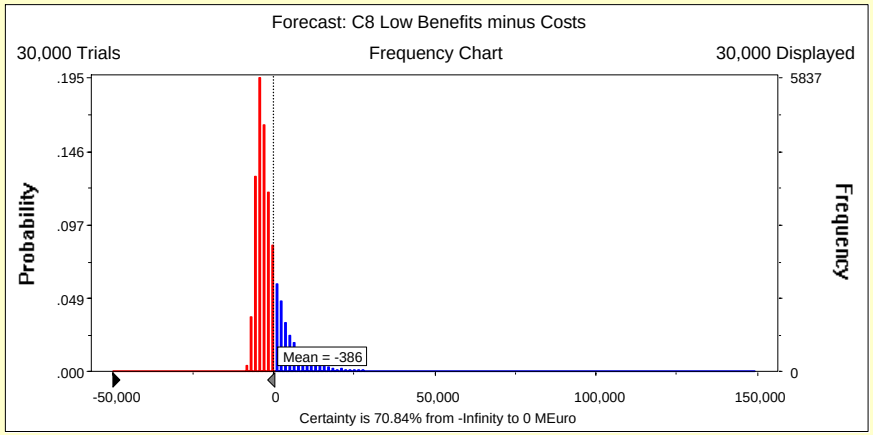
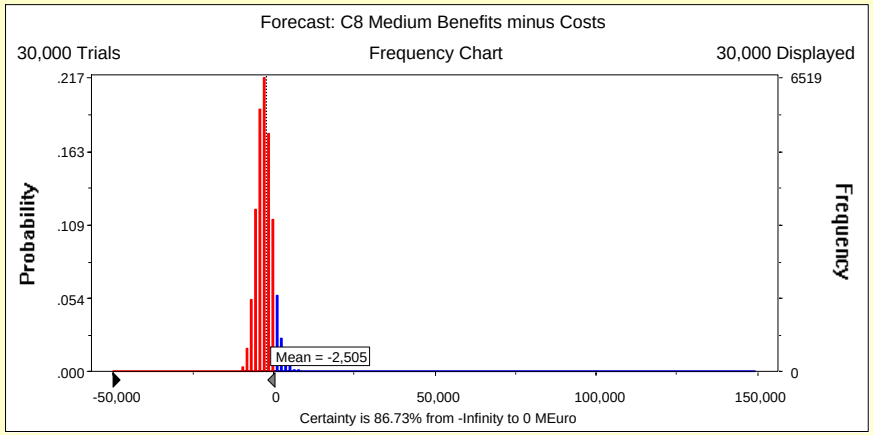
Scenario C8 *Joint Optimisation*

Marginal Benefits minus Marginal Costs; Defra overall average; 0.4% slope; no morbidity

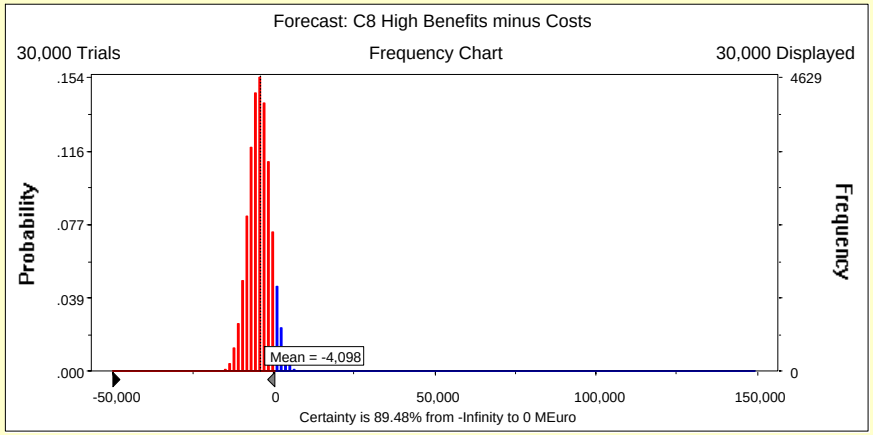
C8 Low; 71% chance of regrets



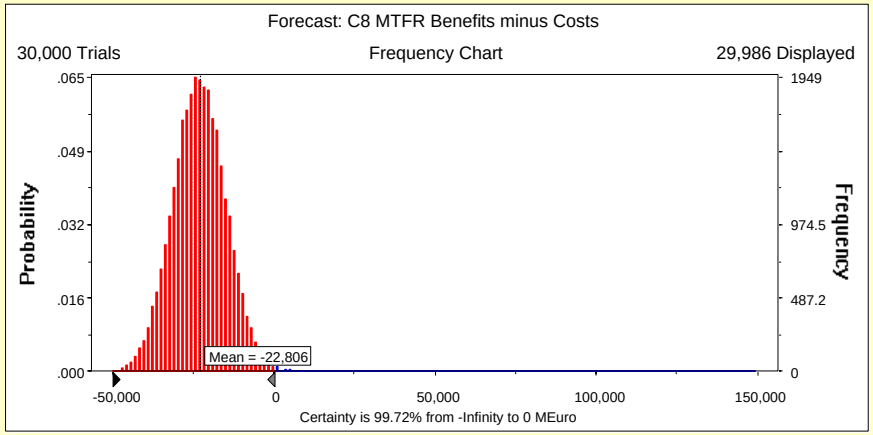
C8 Medium; 87% chance of regrets



C8 High; 89% chance of regrets



C8 MTFR; 100% chance of regrets



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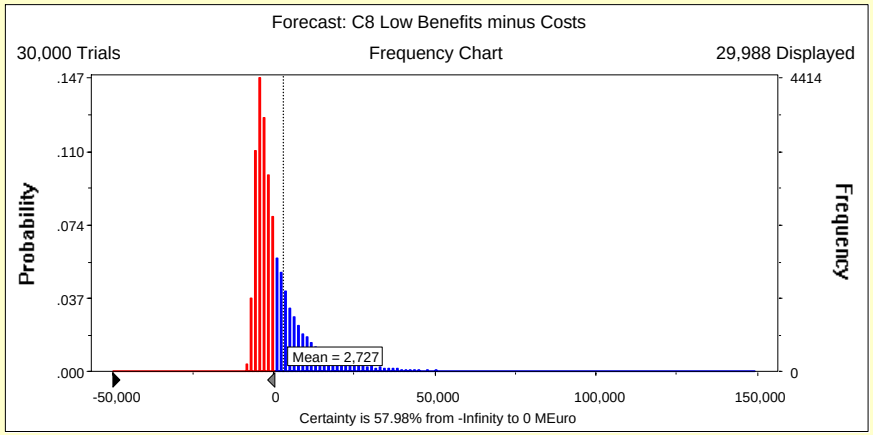
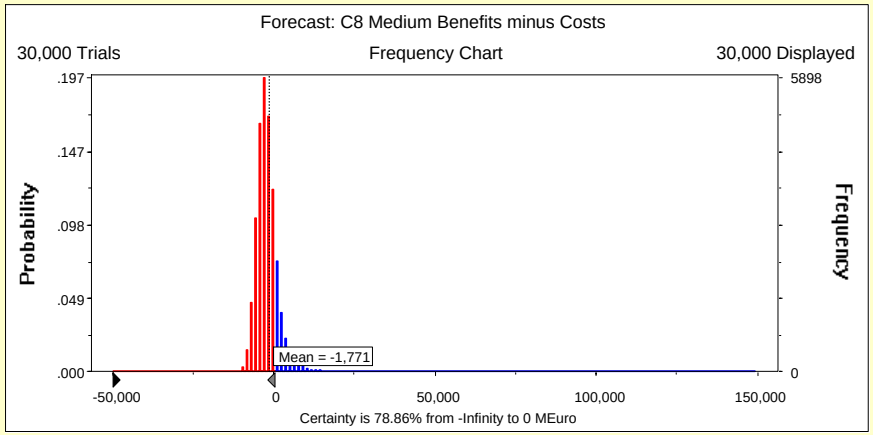
Scenario C8 *Joint Optimisation*

Marginal Benefits minus Marginal Costs; Defra average Normal Health; 0.4% slope; no morbidity

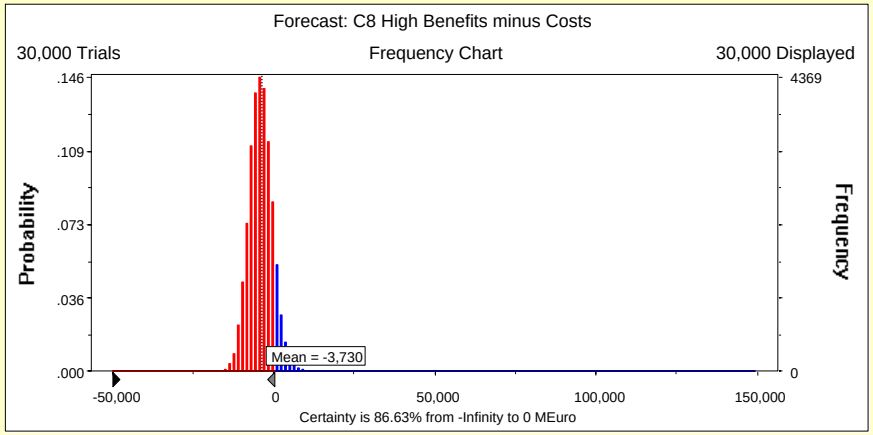
C8 Low; 58% chance of regrets



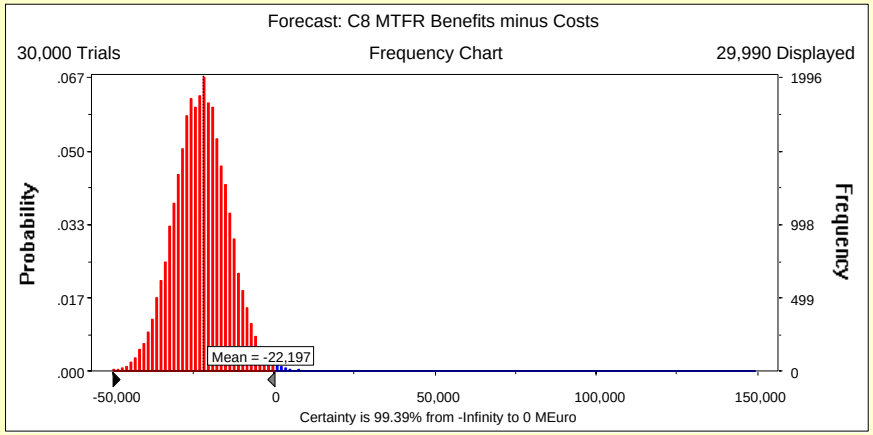
C8 Medium; 79% chance of regrets



C8 High; 87% chance of regrets



C8 MTFR; 99% chance of regrets



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Conclusions

- In air pollution context (CAFE) the relevant metric is VOLY as opposed to VSL
- Studies directly eliciting VOLY are few and far between
- However, Defra commissioned study is high quality study directly eliciting VOLY
- Newext VOLY much higher than those in other studies

- CAFE CBA choice of ambition levels not at all robust when looking at impact of reasonable parameter variations
  - VOLY
  - Morbidity
  - PM ERF slope

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