The value of a statistical life for out-of-hospital cardiac arrest victims

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Abstract

Objective: Economic evaluation of policies regarding out-of-hospital cardiac arrest (OHCA) is important. We therefore estimate the value of a statistical life (VSL) for OHCA victims.
Method: Responses to a national Swedish mail survey in 2007, based on the stated-preference technique (contingent valuation) to directly elicit individuals’ hypothetical willingness to pay for a reduced risk of dying from OHCA.
Results: VSL values are found to be higher than for comparable VSL estimates from the transport sector. A lower-bound estimate of VSL for OHCA would be in range of SEK 20 to 30 million.
Conclusions: The results in this paper indicate that it is not an overestimation to use the ‘baseline’ VSL value from the transport sector (SEK 22 million) in cost-benefit analysis of OHCA policy decisions. We do not support a declining VSL with age, i.e. a ‘senior death discount’, for this cause of death.

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Keywords: Cost-benefit analysis; Willingness to pay; Contingent valuation; Value of a statistical life; Cardiac arrest

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1. Background

The value of a statistical life (VSL) is a measure of the trade-off between income and mortality risk reductions. In essence, this means that VSL is the value that society deems economically efficient to spend on avoiding one (unidentified) premature death. Especially in environmental, health and transport safety economics, VSL is often a key input in policy evaluations when performing cost-benefit analysis (CBA). Implicit VSLs have shown considerable differences in societal investments for lifesaving interventions, which puts into question the rationality behind the implemented policies [1-2].

Economic evaluations regarding out-of-hospital cardiac arrest (OHCA) interventions have almost exclusively relied on performing cost-effectiveness analyses (CEA) or cost-utility analyses (CUA) [3-8]. This is unfortunate since these analyses are less informative than a CBA and since a measure of VSL is essential in optimising policy in fields where weighing the saving of human lives against other effects and costs frequently occur. In fact, we have not found a single study that has specifically estimated VSL in case of an OHCA. The monetary value of a prevented fatality is instead typically based on valuations from the transport sector [9]. We experience different risk scenarios, and individuals who suffer OHCAs are generally older and less healthy than people who die in road traffic accidents. Thus, it is not obvious which measure of VSL should be used and whether the VSL estimates from the transport sector are appropriate to use for evaluations of OHCA interventions.

The aim of this study is to estimate VSL for OHCA based on the stated-preference technique contingent valuation (CV). CV is a survey-based stated preference technique that is used to directly elicit individuals’ hypothetical willingness to pay (WTP) for certain non-market goods or services [10]. The method has been applied to health care since the 70s [11] and although exposed to criticism [12], it has the potential to deliver measures of all costs and consequences in monetary terms. Presenting a CBA as a complement to CEA or CUA may improve the comparability of societal policies as well as rationality.

2. Methods

2.1 Data

The target population for our CV survey consisted of the inhabitants of Sweden and we randomly sampled 1000 individuals aged 17-75. The survey mode was a mail survey that was sent out in June 2007 followed by a...
reminder mailed out three months later in September. Our overall response rate was 43 percent. The valuation scenario and WTP questions for the survey are attached in Appendix. Table 1 summarises the sample statistics. Are the respondents representative for the Swedish population? A logit regression on WTP including the observed demographic variables resulted in significant negative parameter estimates for the population (p=0.084) and the bid level (p=0.000). The self-assessed numbers of inhabitants in the municipalities are high compared to the mean municipality size in Sweden (approximately 32 000). Thus, respondents living in large municipalities are over-represented and the WTP estimates might be biased downwards.

We performed a pilot study with a sample of 100 individuals in May 2007 to pre-test the questionnaire and to establish an interval for the majority of the WTP values. An open-ended (OE) elicitation format was used in the pilot survey, while we used a discrete-continuous CV format in the main study where both dichotomous choice (DC) and OE questions were asked to the same sample of respondents. A dichotomous choice (closed-ended) question may read, ‘How would you vote if... [the good] costs SEK X per year? □Yes □ No’, while an open-ended question reads something like, ‘How much would you at most be willing to pay annually for... [the good]? Answer: ...’ When calculating VSL, the DC data was used since valuing new public goods with coercive payment implies incentive compatibility and also since a binary question better resembles a real market situation. Incentive compatibility implies that ‘a truthful response to the actual question asked constitutes an optimal strategy for the agent’ [13]. However, we used the information of the OE responses when correcting for excluded zero responses in the lognormal model. Of 293 responses to the OE WTP question, 33 responded zero (11 percent).

The valuation scenario was a public programme to increase the survival rate after OHCA by increasing the density of defibrillators in the municipality. Defibrillation was explained to be initiated by firemen, policemen, security guards or nurses, and public access defibrillators may be located in hotels, shopping malls, sports centres and theatres. The willingness to pay for an increased survival rate was elicited as an annual individual fee for 10 years, and the key phrase was, ‘The programme will reduce your own and others’ risk [of dying from cardiac arrest] and the survival rate will be increased from 5 to 10 percent on average’. A provision condition requiring that at least 50 percent of the inhabitants of the municipality must be in favour of the programme for it to be implemented (i.e. a referendum format) was included, according to recommendations by the National Oceanic and Atmospheric Administration (NOAA) panel [14].
Table 1. Sample statistics

<table>
<thead>
<tr>
<th>Variable</th>
<th>Definition</th>
<th>Mean (std.dev.)</th>
<th>Min</th>
<th>Max</th>
<th>N</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female</td>
<td>Gender=female</td>
<td>0.50 (0.50)</td>
<td>0</td>
<td>1</td>
<td>333</td>
</tr>
<tr>
<td>Age</td>
<td>Age of the respondent</td>
<td>48.3 (15.3)</td>
<td>17</td>
<td>75</td>
<td>333</td>
</tr>
<tr>
<td>High education</td>
<td>Education level is at least one term at a university</td>
<td>0.44 (0.50)</td>
<td>0</td>
<td>1</td>
<td>331</td>
</tr>
<tr>
<td>Low education</td>
<td>Education level is at most nine-year compulsory school</td>
<td>0.18 (0.39)</td>
<td>0</td>
<td>1</td>
<td>331</td>
</tr>
<tr>
<td>High risk</td>
<td>Own perceived risk of cardiac arrest is higher than average</td>
<td>0.16 (0.36)</td>
<td>0</td>
<td>1</td>
<td>333</td>
</tr>
<tr>
<td>Low risk</td>
<td>Own perceived risk of cardiac arrest is lower than average</td>
<td>0.41 (0.49)</td>
<td>0</td>
<td>1</td>
<td>333</td>
</tr>
<tr>
<td>Income</td>
<td>The income (SEK) per consumption unit given by the total household income* divided by the number of household members weighted as follows: adult person # 1 = 1.16, adult person # 2 = 0.76, children 0-3 years old = 0.56, children 4-10 years old = 0.66, children 11-17 years old = 0.76</td>
<td>19 223 (10 992)</td>
<td>1220</td>
<td>68966</td>
<td>327</td>
</tr>
<tr>
<td>Population</td>
<td>Number of inhabitants (self-assessed by respondents) of the municipality</td>
<td>147 676 (227 607)</td>
<td>3000</td>
<td>1000000</td>
<td>314</td>
</tr>
<tr>
<td>Heart</td>
<td>The respondent has suffered from heart disease</td>
<td>0.11 (0.31)</td>
<td>0</td>
<td>1</td>
<td>333</td>
</tr>
</tbody>
</table>

* The respondents were asked to mark an interval with a range of SEK 4999. The income was then approximated by using the mid value of the interval.

2.2 Method
Estimating VSL means that we are examining the rate at which people are prepared to trade off income for a reduction in the risk of dying. In a
standard theoretical model of one individual’s baseline mortality risk \( p \) \([0 \leq p \leq 1]\), where \( u_a(y) \) and \( u_d(y) \) are the individual’s utility as a function of income \( y \) conditional on staying alive \( (a) \) and dying \( (d) \), the expected utility is equal to \([15-16]\):

\[
EU[p, y] = (1 - p)u_a(y) + pu_d(y).
\] (1)

The model is simplified to only consider a marginal change in the probability of one individual’s own death and also within a specified time period. Assuming that utility of income is zero when the individual is dead \( (u_d=0) \) simplifies the expression to \((1-p)u_a(y)\). Then the trade-off between income and risk is \([13-14]\):

\[
VSL = \frac{dy}{dp} = \frac{u_a(y)}{(1-p)u'_a(y)}.
\] (2)

In practice, VSL is not estimated by using the derivative, but instead by estimating WTP for a specified risk reduction \( \Delta p \). Then, VSL is estimated as:

\[
VSL = \frac{WTP}{\Delta p}.
\] (3)

Through our CV survey we measure WTP for a hypothetical risk reduction of dying from OHCA and arrive at a VSL measure that is specific for this diagnosis and the scenario in the survey. As far as we know, this is the first estimate of VSL for OHCA ever attempted. The analysis of our CV data follows the recommendations from Bateman et al. \([10]\) regarding the objective to estimate mean and median WTP.

3. Results

First, we examined the proportions of yes-responses by bid amount (Figure 1) and found that they decline from 85 percent at the SEK 200 bid level to 16 percent at the SEK 5000 bid level (€1=SEK 10.53, $1=SEK 7.07; 10 Nov. 2009). The bid levels were chosen to capture the interval of WTP responses from the pilot study, and the sample size of each bid level was 200 questionnaires. As we can see from the figure, the survival function was monotonically decreasing.
Since we have chosen to use the data from dichotomous choice questions, we have to make assumptions about the distribution of the underlying WTP to calculate mean and median WTP. Following Bateman et al. [10] we start by estimating a non-parametric model to derive lower bound estimates of mean and median WTP. Both the more conservative Kaplan-Meier-Turnbull (KMT) estimator and the Spearman-Karber (SK) estimator are calculated. As lower and upper intervals we use SEK 0 and SEK 5000. Table 2 shows that the mean VSL for the conservative KMT model is SEK 49 million and the median VSL SEK 30 million. The marginal risk reduction (Δp) in our CV survey was 3.35/100 000.

Further, we have estimated a variety of constant-only bid function parametric models. A constant-only bid function model includes the parameter estimate for the constant alone, i.e. $WTP_k = \beta_{constant} + \varepsilon_k$ for logit and probit distributions the WTP function for individual k is (see Appendix). The confidence intervals from all parametric estimations of mean and median WTP are numerically estimated by employing bootstrapping with 10 000 replications. The variation of VSL values is large, but none of the values are smaller than the non-parametric KMT estimates. The ‘best’ parametric model, i.e. the model with the highest value for the likelihood function [10], is the lognormal distribution. However, we notice that the differences are small. The lognormal distribution restricts WTP to be non-negative. Negative WTP is plausible since we value a public good, yet we
regard it to be unlikely that a respondent would reject the programme if it were offered for free. The lognormal model rules out the possibility of zero WTP, but we also introduce a mixed spike/lognormal model that account for this possibility.

Table 2. Mean and median VSL (million SEK) for various distributional assumptions.

<table>
<thead>
<tr>
<th></th>
<th>Mean VSL</th>
<th>95 percent CI</th>
<th>Median VSL</th>
<th>95 percent CI</th>
<th>Log-likelihood</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Non-parametric models</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Kaplan-Meier-Turnbull</td>
<td>49</td>
<td>39-58</td>
<td>30</td>
<td>0-149</td>
<td>-</td>
</tr>
<tr>
<td>Spearman-Karber</td>
<td>65</td>
<td>61-70</td>
<td>49</td>
<td>2-149</td>
<td>-</td>
</tr>
<tr>
<td><strong>Parametric models</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Probit</td>
<td>65</td>
<td>53-78</td>
<td>65</td>
<td>53-78</td>
<td>-181.67</td>
</tr>
<tr>
<td>Logit</td>
<td>63</td>
<td>51-78</td>
<td>63</td>
<td>51-78</td>
<td>-181.58</td>
</tr>
<tr>
<td>Logit positive</td>
<td>73</td>
<td>58-89</td>
<td>73</td>
<td>58-89</td>
<td>-181.58</td>
</tr>
<tr>
<td>Lognormal</td>
<td>144</td>
<td>84-354</td>
<td>41</td>
<td>33-53</td>
<td>-180.58</td>
</tr>
<tr>
<td>Mixed spike/lognormal</td>
<td>126</td>
<td>74-321</td>
<td>36</td>
<td>29-48</td>
<td>-180.58</td>
</tr>
</tbody>
</table>

Notes: Specifications of the distributions are included in Appendix

So far, we have implicitly assumed that the responders (43 percent) are representative for the non-responders as well. We have not analysed the non-responses specifically, but a conservative assumption would be to treat the non-responses as ‘no’-answers [16]. For the non-parametric models this would imply a mean/median VSL of MSEK 15/0 (KMT) and MSEK 22/4 (SK). Probit and logit parametric estimates would be negative, yet mean/median VSL would be MSEK 23 (logit positive), MSEK 130/2 (lognormal) and MSEK 34/1 (mixed spike/lognormal). All VSL estimates decrease significantly, except for the lognormal distribution.
Mean VSL is larger than median VSL for the lognormal models and for the non-parametric models. This indicates a positively skewed distribution. Median VSL can be said to be a more robust measure than mean VSL since it is not so greatly influenced by a few high VSL values or by the chosen distributional assumption. However, the choice of mean or median VSL is also a choice between an efficiency criteria and a majority voting rule as well as an ethical decision [10, 17-18]. If the mean VSL is higher than the cost per head, then the project should proceed since the losers can be compensated by the gainers (Hicks-Kaldor criteria). On the other hand, if median VSL is higher than the cost per head, then we know that a majority of the respondents would vote in favour of the project.

4. Discussion

In this paper, we have attempted the first estimation, to our knowledge, of the value of a statistical life for out-of-hospital cardiac arrest. The estimate is sensitive to assumptions of the distribution, although this is not an unusual feature of stated preference surveys [16]. Also, that different methods give different results is not the core message of our paper. Instead, we regard this result as a sensitivity analysis of our value of a statistical life (VSL) estimate. What we would like to highlight is that we find that the estimates are consistently higher than the official VSL for road traffic safety in Sweden, which is estimated to SEK 22 million [19].

The traffic VSL is established from a number of contingent valuation (CV) surveys and is the ‘baseline’ VSL in Sweden, since it is the most used and explored. The distributional assumptions made for estimating the road-traffic VSL is usually a probit, logit or probit positive. VSL values for road traffic casualties are roughly the same in similar European countries [20], and in Sweden the estimates based on stated preference studies generally are in the range of SEK 15 to 50 million [21-23]. The method we used in asking WTP questions in our survey is very similar to the technique used for eliciting traffic VSL.

Our hypothesis was that the VSL for OHCA would be lower than SEK 22 million, since statistical lives are both longer and ‘healthier’ for road traffic victims. It has been shown that heterogeneity of VSL regarding various ages is substantial, and international practices have often been to decrease VSL with age, i.e. a ‘senior death discount’ [24-26]. On the other hand, this policy has also been argued not to be supported by theoretical or empirical findings [26-27]. Our results do not support the practice of decreasing VSL with age for victims of cardiac arrest.

A speculation about why this unexpected difference exists could be that differences between questionnaire designs and contexts have an effect. A
second possibility is that the cause of death is important when examining WTP using CV, as was found by Norinder et al. [28]. We might measure some kind of preference for ‘individual freedom’, compared to further road traffic safety measures that are perceived as limiting freedom of action (e.g. speed cameras, seat belts, helmets). An increased density of defibrillators does not affect individuals in this way. Also, we may capture solidarity with older and helpless individuals suffering from an OHCA, while road-users are perceived to have more controllable risks to manage. The qualitative characteristics of a risk have been shown to affect WTP, and WTP is usually reduced if the target group of the intervention is perceived as being blameworthy of the risk [24, 29].

It is fair to say that the stated preference technique in general – in this case represented by the contingent valuation method – and our survey in particular suffer from a number of potential biases and limitations. Using surveys to ask about hypothetical payments may result in e.g. hypothetical bias, where individuals’ WTP from the hypothetical scenario deviate from WTP in a real market situation, or in scope/scale bias, where individuals are insensitive to the amount of a good (scope) or the size of a good (scale). In the face of these uncertainties, we consider the method a possibility to achieve an indication of the value of non-market goods.

We do not intend to draw too far-reaching conclusions from only one small sample survey. Although data suggests that a lower bound of VSL for OHCA would be in the range of SEK 20 to 30 million, it might in fact be significantly higher. We recommend that a conservative approach be taken when applying our estimates for cost-benefit purposes and that it be used as a complement to CEA and/or CUA analyses. At the same time, the results indicate that there probably is no reason to suspect that the baseline VSL value used in the transport sector (SEK 22 million) constitutes an overestimation when used in connection with OHCA interventions.
Acknowledgements

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References


Appendix

A1. The valuation scenario and WTP questions for the contingent valuation survey

Each year a number of individuals suffer a cardiac arrest in your municipality. Imagine that there are ways to reduce mortality risks for cardiac arrests. We will ask you about your willingness to pay for such measures. Remember that the money you are willing to pay for security improvements reduces your possibilities to consume other things.

To reduce the mortality risk, a public programme to increase the density of defibrillators is considered. One possibility is to equip and educate employees within certain professions in the municipality who may respond faster than the ambulance. These professions might include firemen, policemen, security guards and nurses. Public access defibrillators may be located in hotels, shopping malls, sports centres and theatres.

A prerequisite for the programme to be implemented is that at least 50% of the individuals in your municipality are positive to the introduction of the programme. The cost is paid as an annual fee. If the individuals do not contribute enough with the fee, the programme will not be imposed.

What is the effect of the programme?

The programme will result in your own risk as well as the risk of all other individuals in your municipality being reduced, and the survival rate will increase from 5% to 10% on average. The table presents the effect of the programme for various municipality sizes.

Observe that the table represents effects over 10 years!
<table>
<thead>
<tr>
<th>Inhabitants</th>
<th>Number of out-of-hospital cardiac arrests over 10 years</th>
<th>Number of survivors over 10 years (before), 5 %</th>
<th>Number of survivors over 10 years (after), 10 %</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 000</td>
<td>70</td>
<td>3</td>
<td>7</td>
<td>+4</td>
</tr>
<tr>
<td>20 000</td>
<td>130</td>
<td>6</td>
<td>13</td>
<td>+7</td>
</tr>
<tr>
<td>30 000</td>
<td>200</td>
<td>10</td>
<td>20</td>
<td>+10</td>
</tr>
<tr>
<td>50 000</td>
<td>330</td>
<td>16</td>
<td>33</td>
<td>+17</td>
</tr>
<tr>
<td>75 000</td>
<td>500</td>
<td>25</td>
<td>50</td>
<td>+25</td>
</tr>
<tr>
<td>100 000</td>
<td>670</td>
<td>33</td>
<td>67</td>
<td>+34</td>
</tr>
<tr>
<td>150 000</td>
<td>1000</td>
<td>50</td>
<td>100</td>
<td>+50</td>
</tr>
<tr>
<td>250 000</td>
<td>1670</td>
<td>83</td>
<td>167</td>
<td>+84</td>
</tr>
<tr>
<td>500 000</td>
<td>3350</td>
<td>167</td>
<td>335</td>
<td>+168</td>
</tr>
<tr>
<td>750 000</td>
<td>5020</td>
<td>251</td>
<td>502</td>
<td>+251</td>
</tr>
</tbody>
</table>

Example from the table: In a municipality of 10 000 individuals, 70 persons will suffer an out-of-hospital cardiac arrest during a 10-year period on average. Now 3 persons will survive and after the programme 7 persons will survive, which implies an increase of 4 persons over 10 years.

Question 10. How would you vote if your personal fee was SEK 200 per year (i.e. total SEK 2000 for 10 years) for this programme to be implemented in your municipality?

I would vote: □ Yes □ No

Question 12. Provided that the programme is carried out, what is the maximum amount that you would be willing to pay annually for the implementation of the programme, which reduces your own risk as well as the risk of all other individuals in your municipality for cardiac arrest mortality?

Answer: ..............SEK per year

Note: The survey was divided into two sub-samples that use two different aids to communicate the risk reduction. We present the valuation scenario of the ‘flexible community analogy’, but also used an array of dots. There was no difference in WTP between the samples.
A2. Specification of the estimation method

**Kaplan-Meier-Turnbull**

\[
\text{Mean WTP} = E_{\text{KMT}}(\text{WTP}) = \sum_{k=1}^{K} t_k (P_k - P_{k+1})
\]

where \( K \) is the number of bids, \( t_k \) is the bid level, \( P_k \) is the observed share of yes-responses at bid level \( t_k \) and

\[
\text{Var}(E_{\text{KMT}}) = \sum_{k=1}^{K} \frac{P_k (1 - P_k)}{N_k} (t_k - t_{k-1})^2
\]

\( N_k \) is the sample size at bid level \( t_k \), \( t_0 = 0 \), \( P_0 = 1 \) and \( P_{K+1} = 0 \).

**Spearman-Karber**

\[
\text{Mean WTP} = E_{\text{SK}}(\text{WTP}) = \sum_{k=0}^{K} \frac{(t_k + t_{k+1})(P_k - P_{k+1})}{2}
\]

where \( t_{k+1} \) is the upper interval (=SEK 5000 in our case) and

\[
\text{Var}(E_{\text{SK}}) = \sum_{k=2}^{K} \frac{P_k (1 - P_k)}{4(N_k - 1)} (t_k - t_{k-1})^2
\]

**Probit and Logit**

For both probit and logistic distributions the linear constant-only WTP function for individual \( k \) is

\[ WTP_k = \beta_{\text{const}} + \epsilon_k \]
where

\[ \varepsilon_k \sim N(0, \sigma^2) \quad \text{probit} \]
\[ \varepsilon_k \sim N(0, \pi^2 \tau^2 / 3) \quad \text{logit} \]

The probability of accepting a certain bid \( t_k \) for normal and logistic distributions is then

\[ P[\text{Yes}] = 1 - \Phi \left( \frac{t_k - \beta_{\text{const tan} t}}{\sigma} \right) = 1 - \Phi(\lambda t_k - \beta^*) \]

\[ \lambda = 1/\sigma, \ \beta^* = \beta_{\text{const tan} t} / \sigma \]

and

\[ P[\text{Yes}] = 1 - \Lambda \left( \frac{t_k - \beta_{\text{const tan} t}}{\tau} \right) = 1 - \Lambda(\lambda t_k - \beta^*) \]

\[ \lambda = 1/\tau, \ \beta^* = \beta_{\text{const tan} t} / \tau \]

where \( \Phi \) and \( \Lambda \) are the standard normal and standard logistic cdf respectively. Both distributions are symmetric and, therefore, mean WTP is equal to median WTP. For a constant-only bid function,

\[ \text{Mean } WTP_1 = \text{Median } WTP_1 = -\frac{\beta_{\text{const tan} t}}{\beta_{\text{bid}}} \]

Logit positive

The second calculation method for logistic distribution allows for negative values as well, but when calculating mean WTP the WTP is set equal to zero for the proportion of the distribution with predicted negative WTP [30]:

\[ \text{Mean } WTP_2 = \text{Median } WTP_2 = -\frac{1}{\beta_{\text{bid}}} \ln\left[1 + \exp(\beta_{\text{const tan} t})\right] \]
Lognormal

The lognormal model restricts WTP to be non-negative by using an exponential constant-only WTP function:

\[ WTP_k = \exp(\beta \cdot \tan^2 + \epsilon_k) \quad \epsilon \sim N(0, \sigma^2) \]

The probability of accepting a certain bid \( t_k \) is then

\[ P[Yes] = 1 - \Phi \left( \ln t_k - \frac{\beta \cdot \tan^2}{\sigma} \right) = 1 - \Phi(\lambda \ln t_k - \beta^*) \]

\( \lambda = 1/\sigma, \quad \beta^* = \beta/\sigma \)

and

\[ \text{Mean WTP} = \exp \left( 0.5 \times \left( \frac{1}{\beta_{\log \text{bid}}} \right)^2 \frac{\beta \cdot \tan^2}{\beta_{\log \text{bid}}} \right) \]

\[ \text{Median WTP} = \exp \left( - \frac{\beta \cdot \tan^2}{\beta_{\log \text{bid}}} \right) \]

Mixed spike/lognormal

Correction for the lognormal model’s exclusion of zero WTP can easily be done by multiplying mean and median WTP by the probability \((1-\rho)\) that the individuals will have a positive WTP. In our case \(\rho\) is equal to 0.11 (Section 2.1).
BJÖRN SUND  Economic evaluation, value of life, stated preference methodology and determinants of risks