Cost-effectiveness acceptability curve plots

```
library(BCEA)
library(dplyr)
library(reshape2)
library(ggplot2)
library(purrr)
```

The intention of this vignette is to show how to plot different styles of cost-effectiveness acceptability curves using the BCEA package.

Two interventions only

This is the simplest case, usually an alternative intervention ($i = 1$) versus status-quo ($i = 0$).

The plot show the probability that the alternative intervention is cost-effective for each willingness to pay, k,

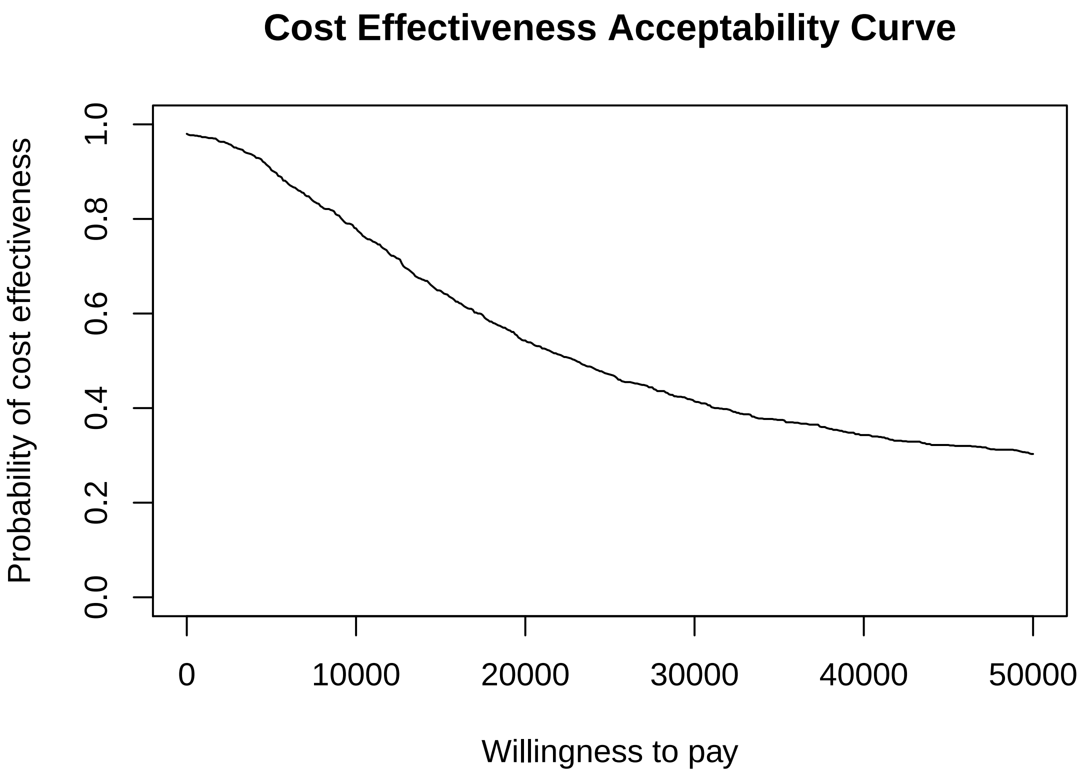
$$p(NB_1 \geq NB_0|k) \text{ where } NB_i = ke - c$$

Using the set of N posterior samples, this is approximated by

$$\frac{1}{N}\sum_j^N \mathbb{I}(k\Delta e^j - \Delta c^j)$$

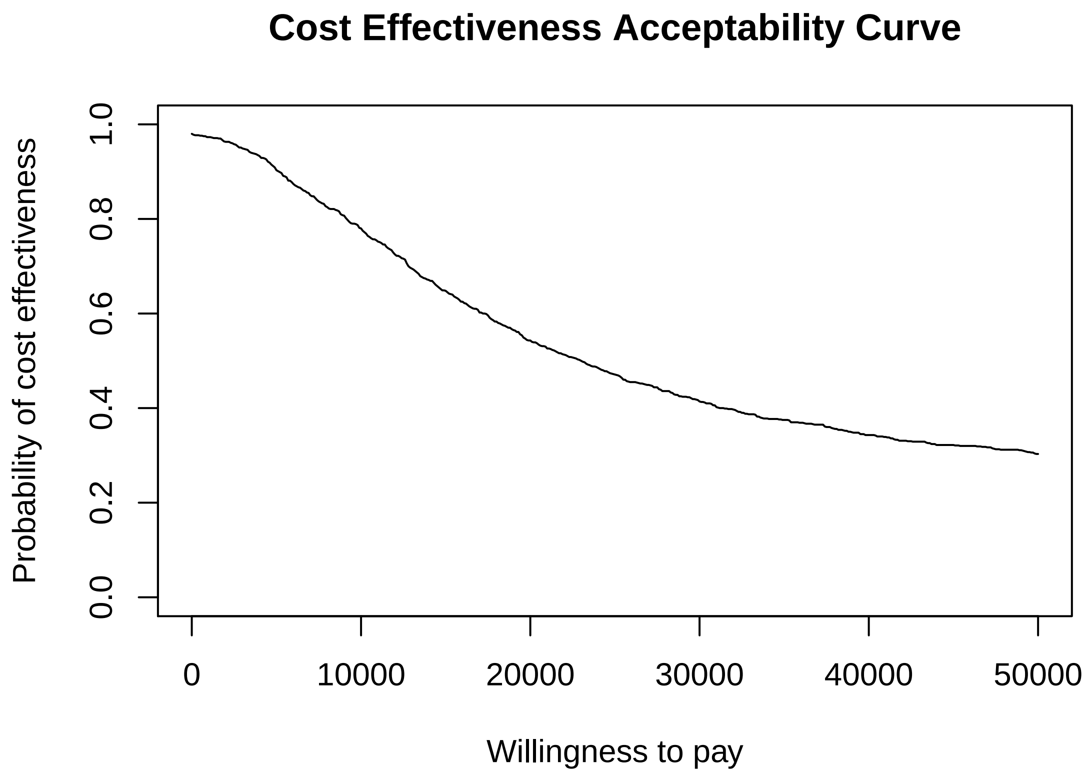
To calculate these in BCEA we use the `bcea()` function.

```
data("Vaccine")

he <- bcea(e, c)
# str(he)

ceac.plot(he)
```

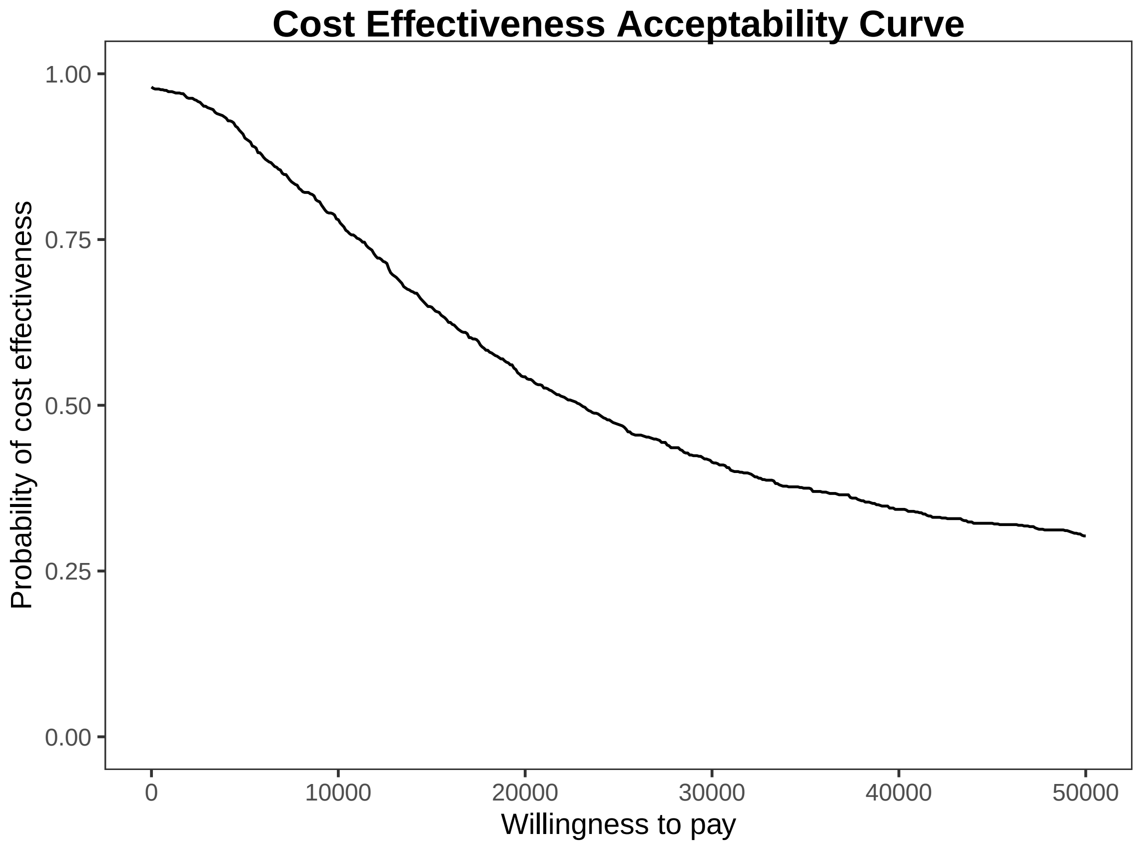


The plot defaults to base R plotting. Type of plot can be set explicitly using the `graph` argument.

```
ceac.plot(he, graph = "base")
```



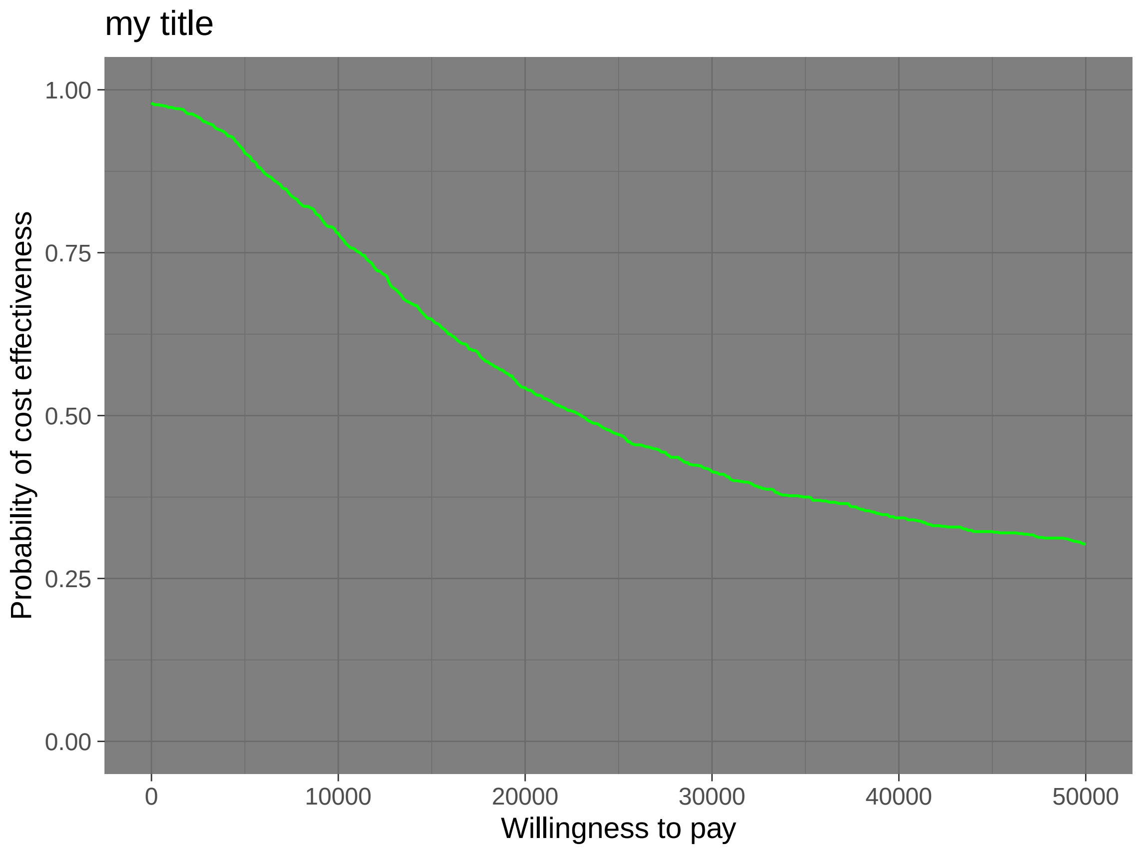

```r
ceac.plot(he, graph = "ggplot2")
```




```
# ceac.plot(he, graph = "plotly")
```

Other plotting arguments can be specified such as title, line colours and theme.

```
ceac.plot(he,
          graph = "ggplot2",
          title = "my title",
          line = list(colors = "green"),
          theme = theme_dark())
```



Multiple interventions

This situation is when there are more than two interventions to consider. Incremental values can be obtained either always against a fixed reference intervention, such as status-quo, or for all pair-wise comparisons.

Against a fixed reference intervention

Without loss of generality, if we assume that we are interested in intervention $i = 1$, then we wish to calculate

$$p(NB_1 \geq NB_s|k) \;\; \exists \; s \in S$$

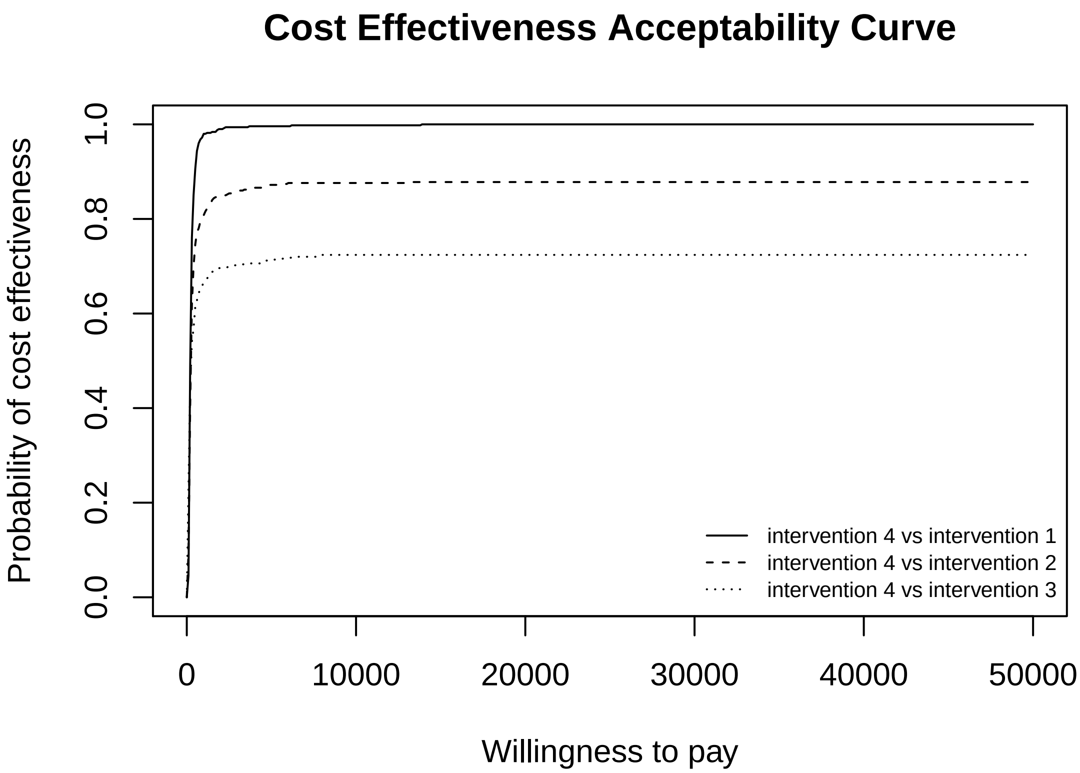
Using the set of N posterior samples, this is approximated by

$$\frac{1}{N} \sum_j^N \mathbb{I}(k \Delta e_{1,s}^j - \Delta c_{1,s}^j)$$

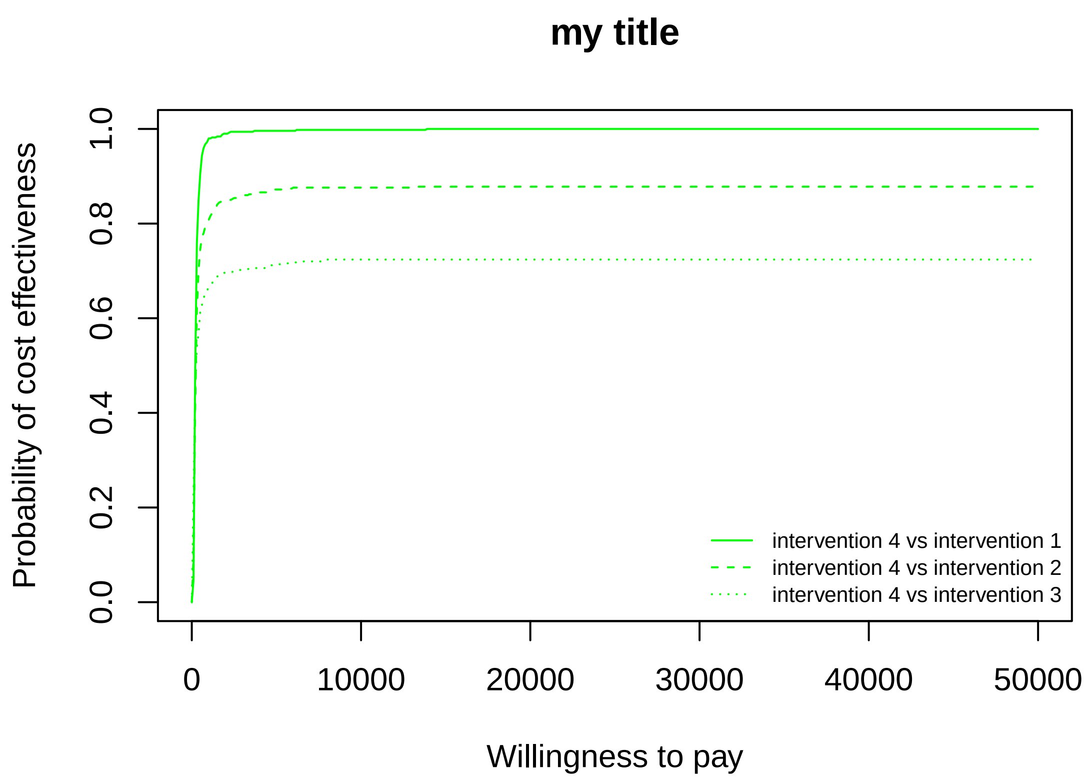
This is the default plot for `ceac.plot()` so we simply follow the same steps as above with the new data set.

```
data("Smoking")

he <- bcea(e, c, ref = 4)
# str(he)
```

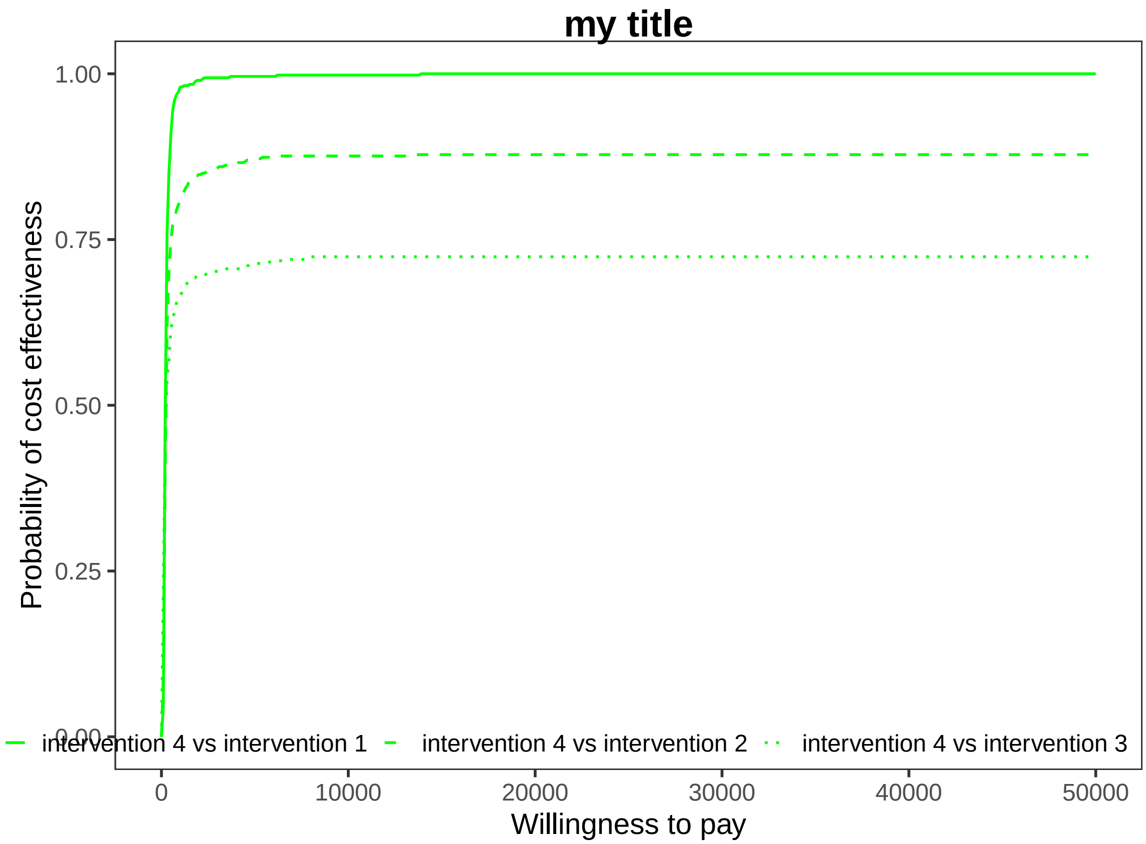
```
ceac.plot(he)
#> Wrong number of colours provided. Falling back to default
```




```
ceac.plot(he,
          graph = "base",
          title = "my title",
          line = list(colors = "green"))
#> Wrong number of colours provided. Falling back to default
```

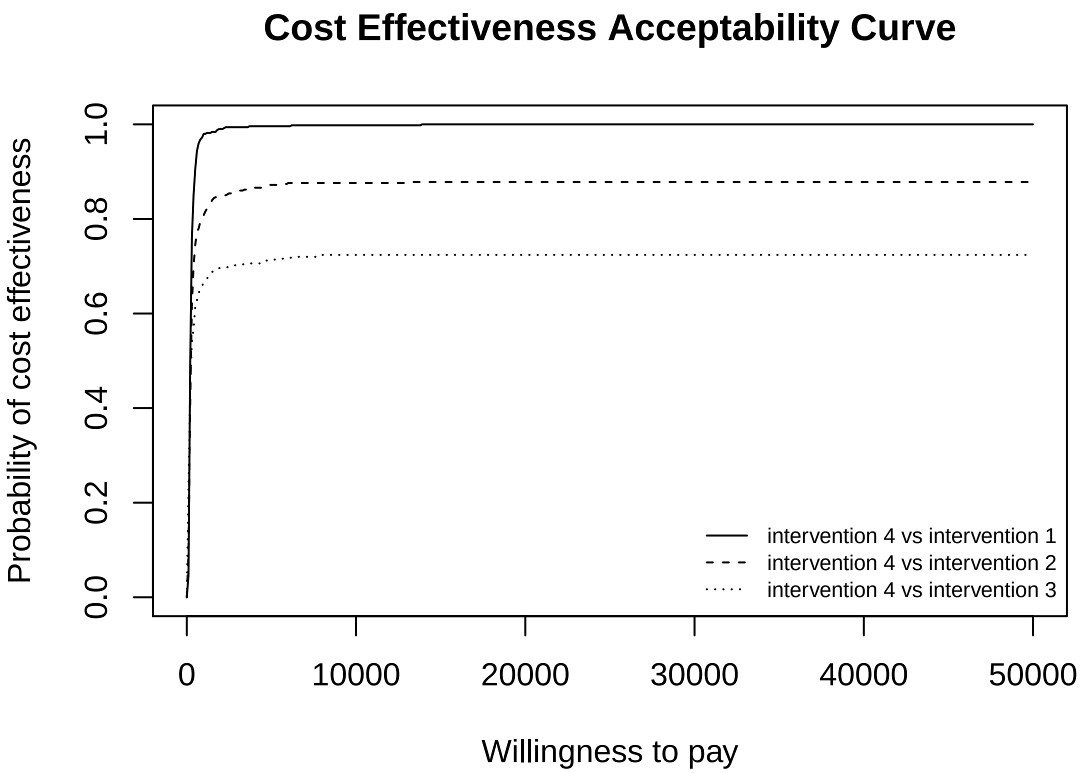



```
ceac.plot(he,
          graph = "ggplot2",
          title = "my title",
          line = list(colors = "green"))
```

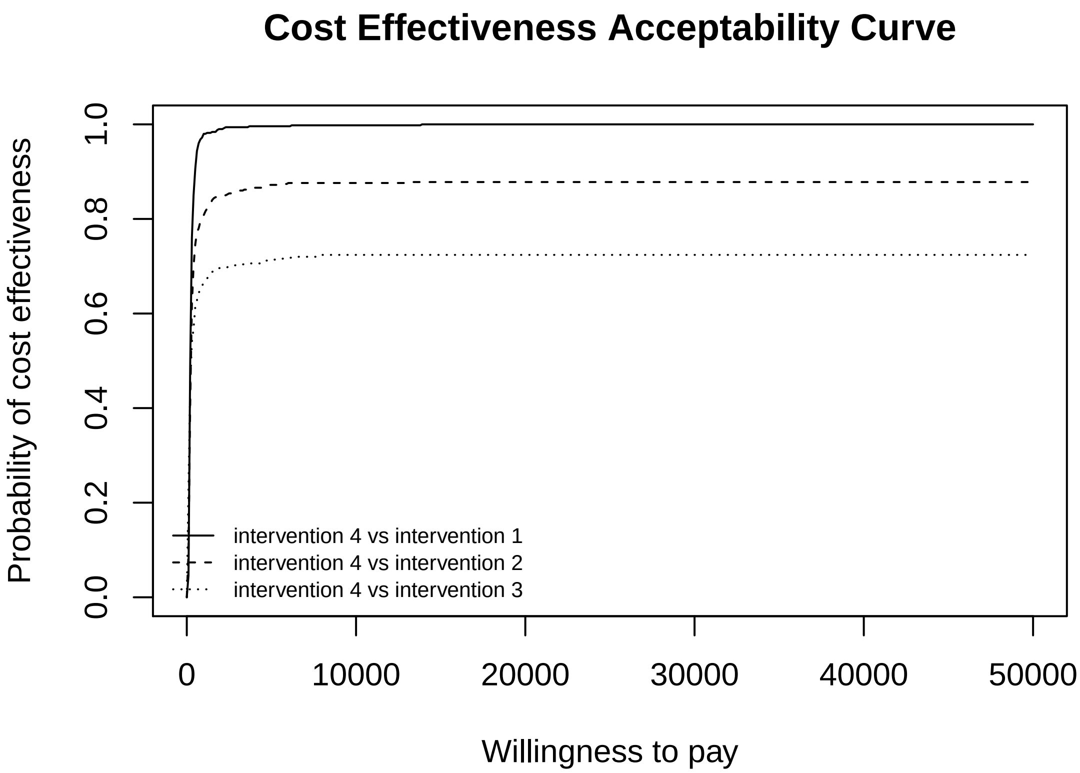


Reposition legend.

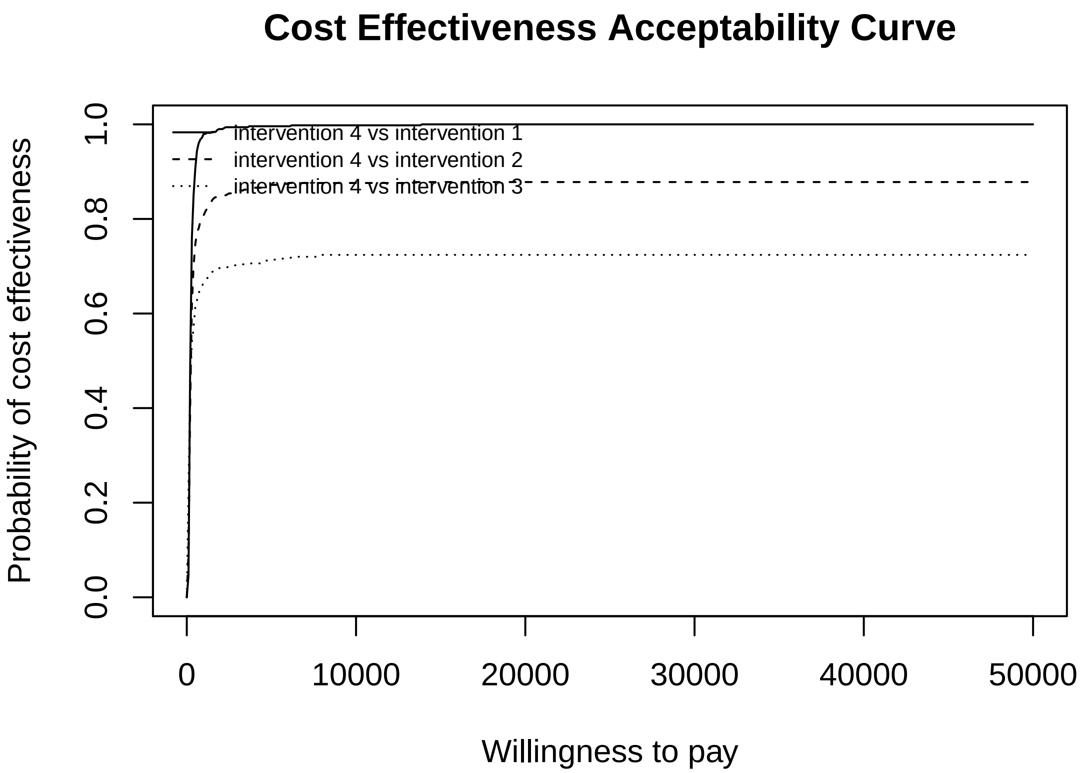
```
ceac.plot(he, pos = FALSE) # bottom right
#> Wrong number of colours provided. Falling back to default
```



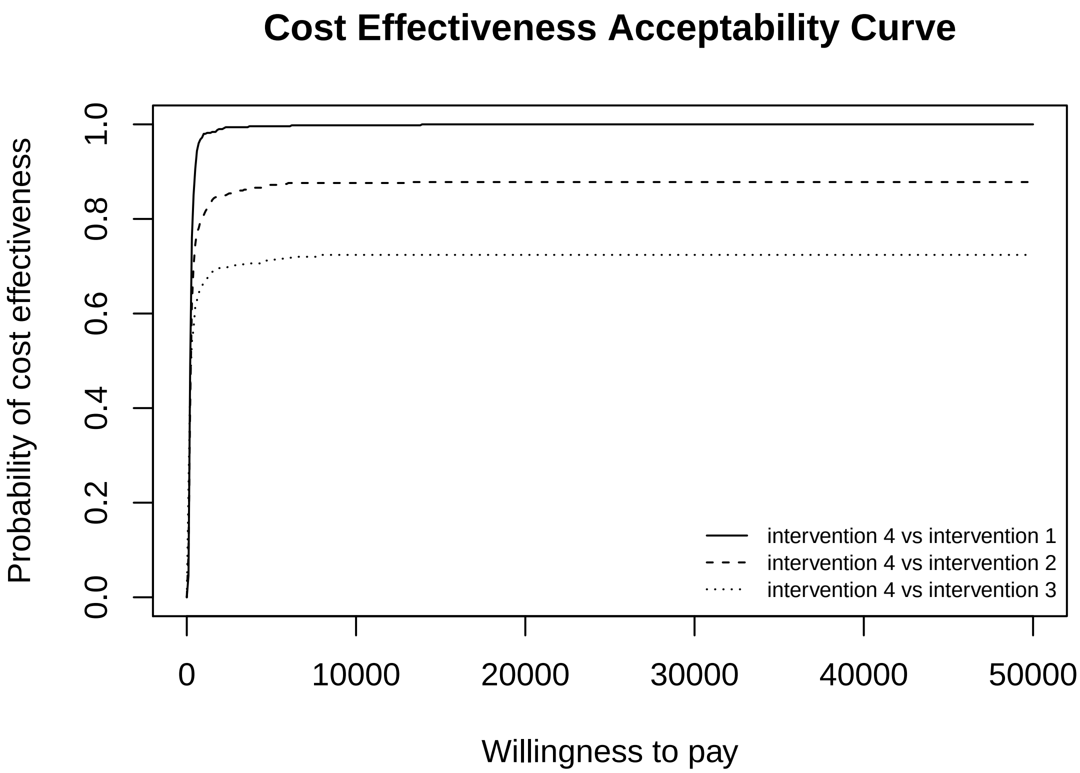

```
ceac.plot(he, pos = c(0, 0))
#> Wrong number of colours provided. Falling back to default
```



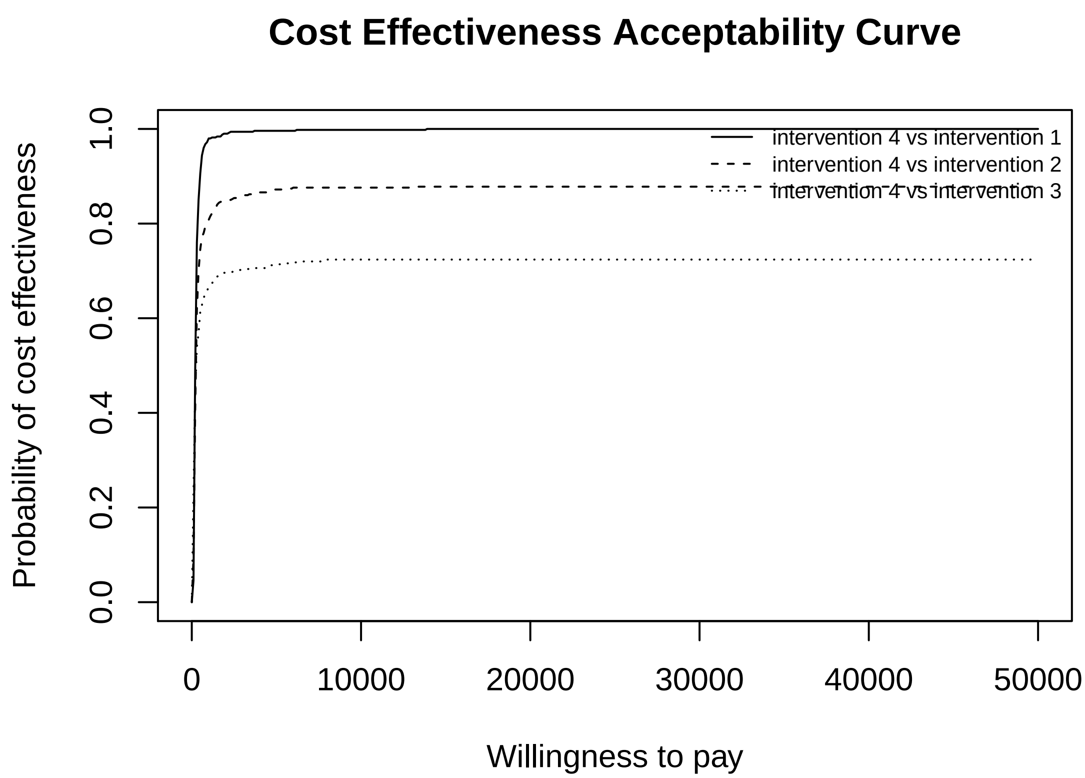

```r
ceac.plot(he, pos = c(0, 1))
#> Wrong number of colours provided. Falling back to default
```



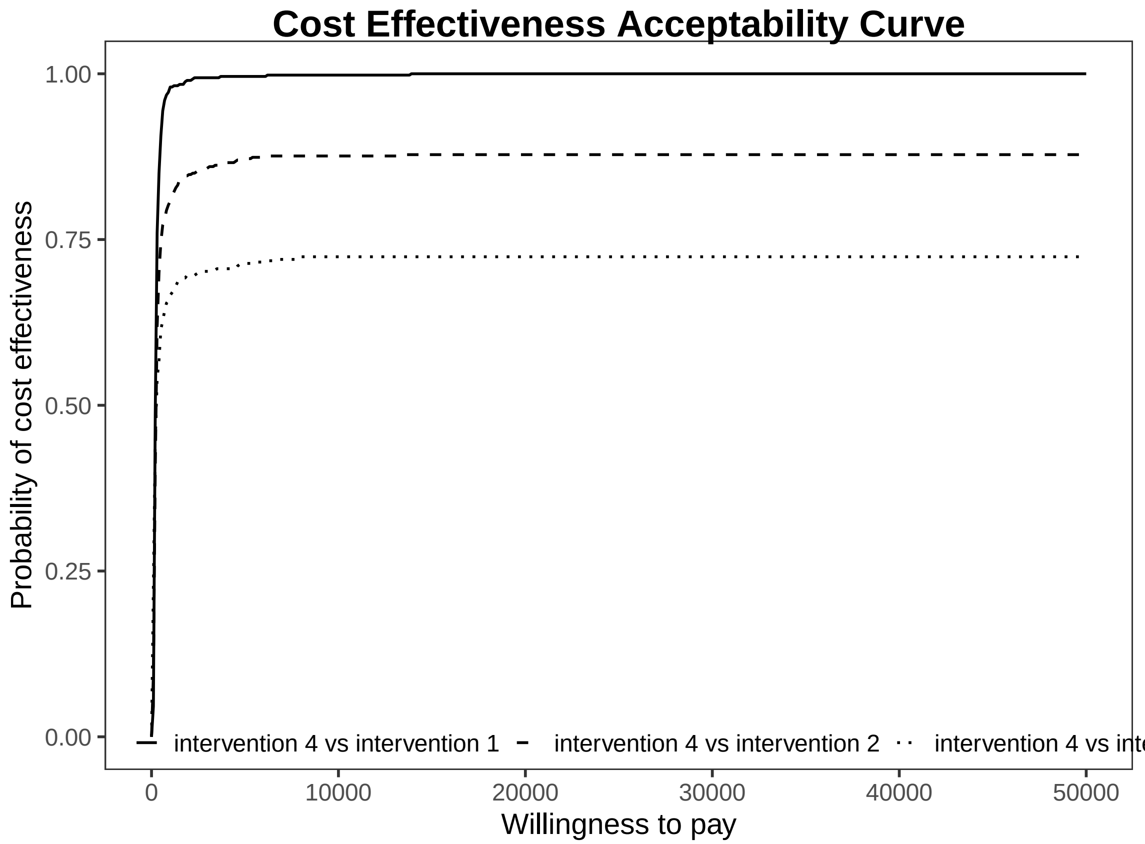

```r
ceac.plot(he, pos = c(1, 0))
#> Wrong number of colours provided. Falling back to default
```



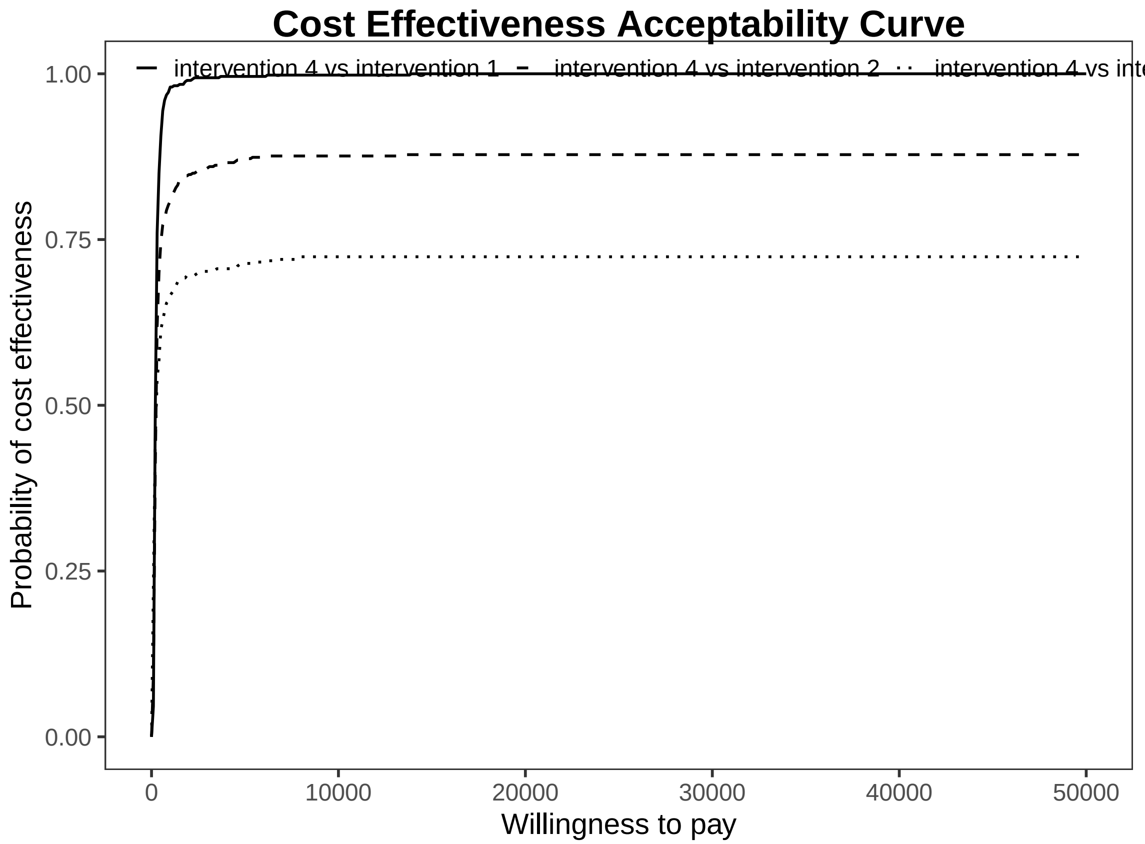

```
ceac.plot(he, pos = c(1, 1))
#> Wrong number of colours provided. Falling back to default
```



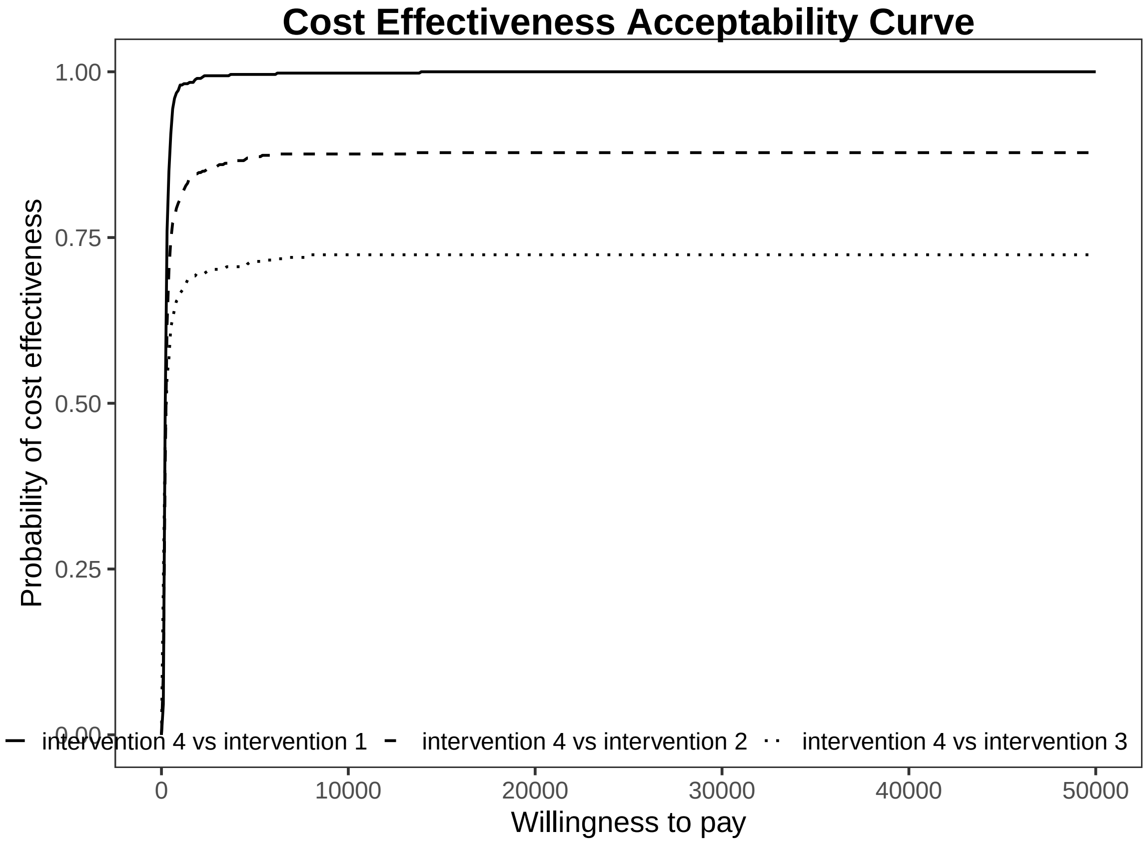

```
ceac.plot(he, graph = "ggplot2", pos = c(0, 0))
```



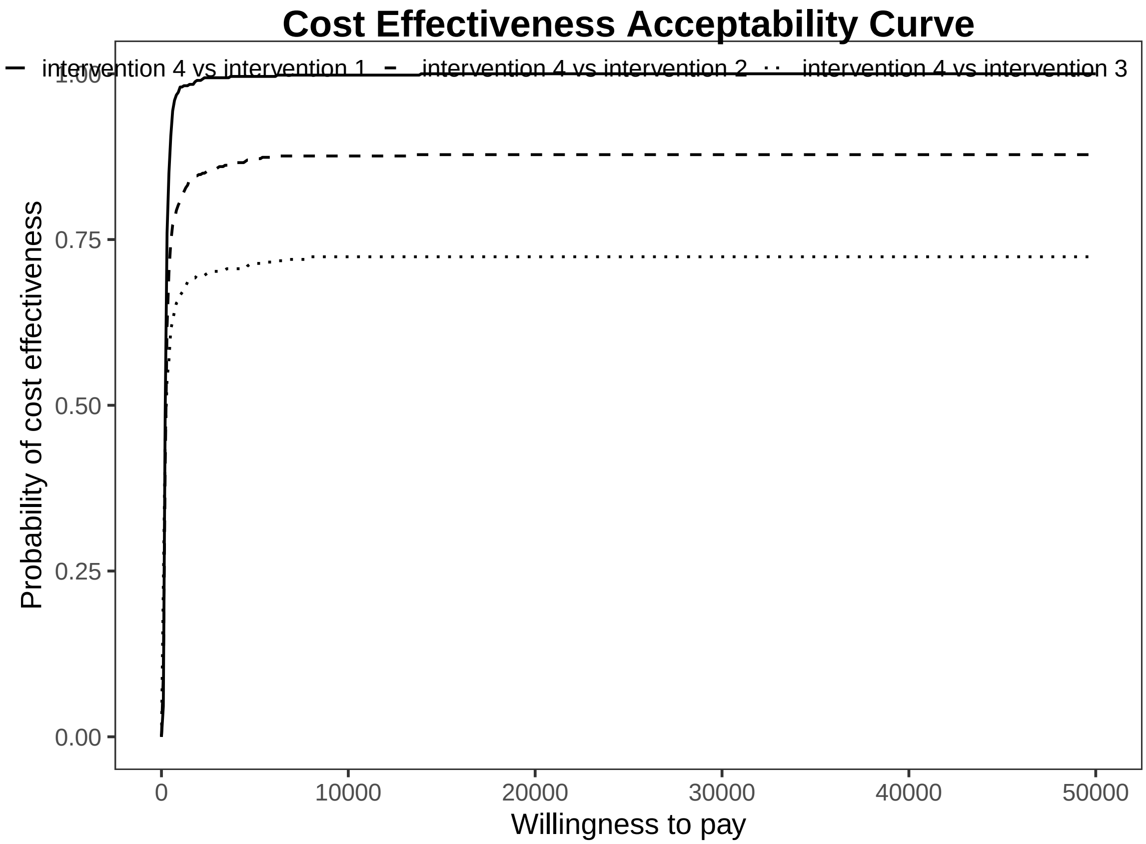

```r
ceac.plot(he, graph = "ggplot2", pos = c(0, 1))
```




```
ceac.plot(he, graph = "ggplot2", pos = c(1, 0))
```

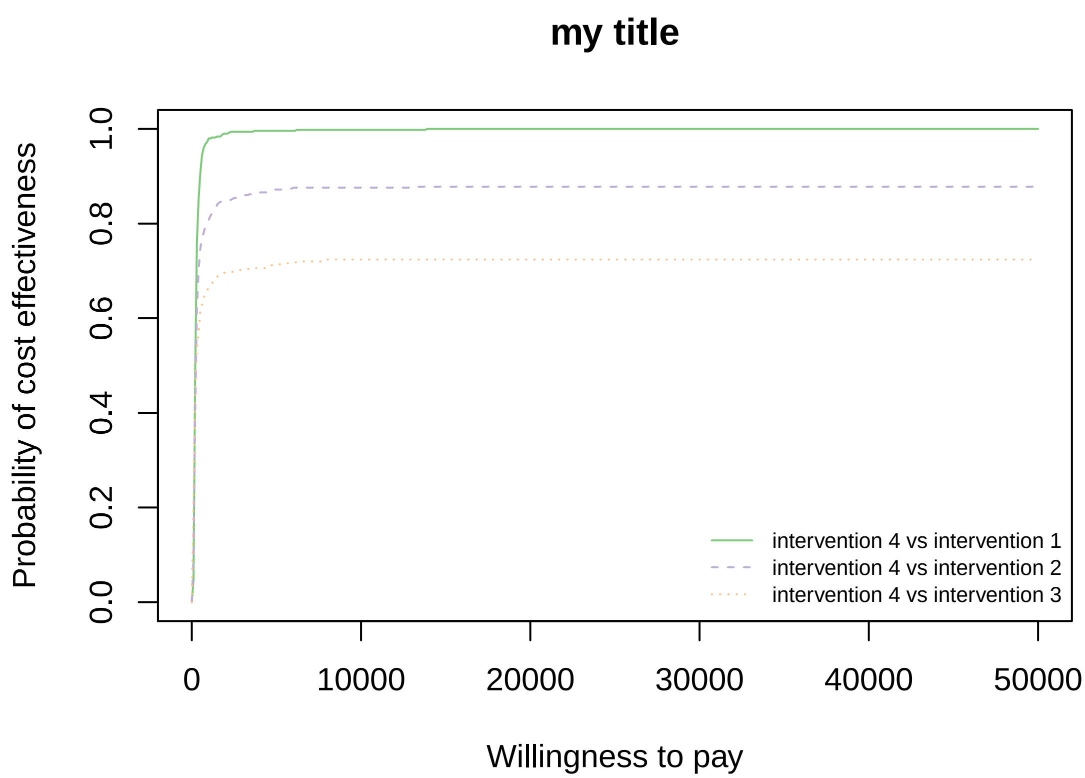



```
ceac.plot(he, graph = "ggplot2", pos = c(1, 1))
```

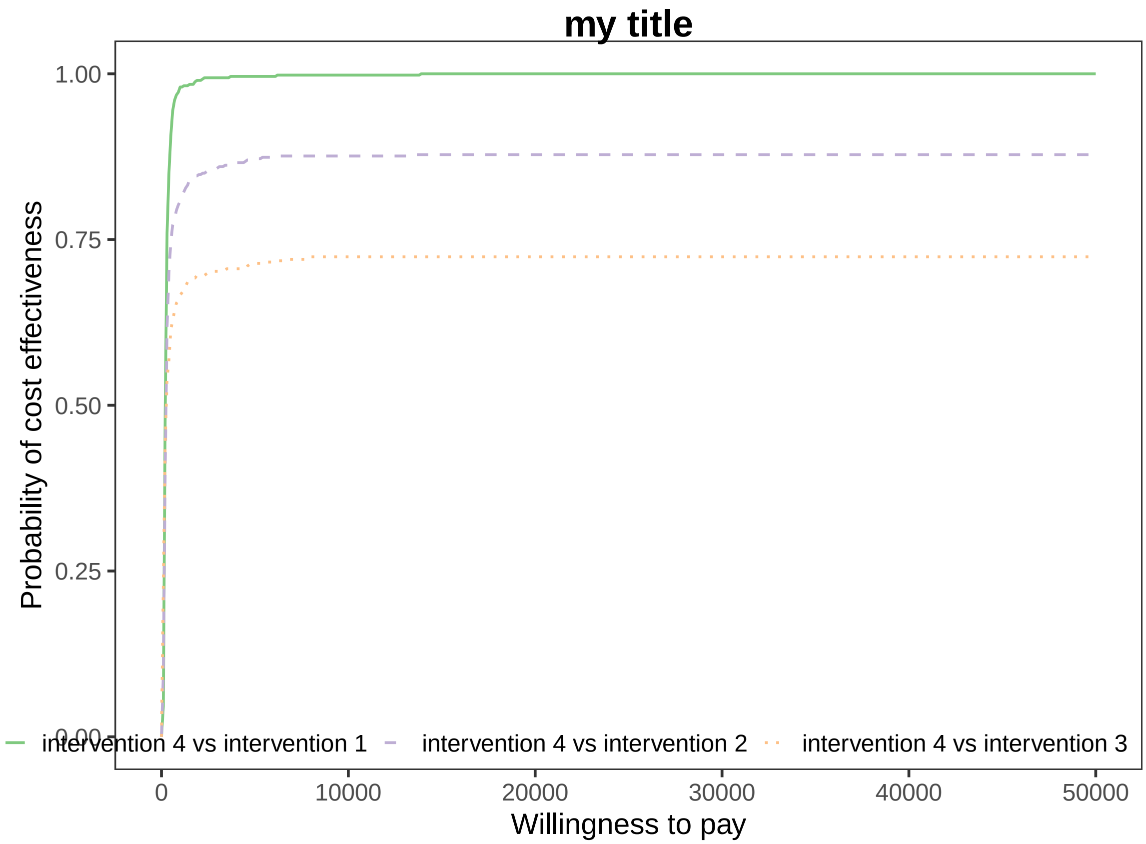


Define colour palette.

```
mypalette <- RColorBrewer::brewer.pal(3, "Accent")

ceac.plot(he,
          graph = "base",
          title = "my title",
          line = list(colors = mypalette),
          pos = FALSE)
```




```r
ceac.plot(he,
          graph = "ggplot2",
          title = "my title",
          line = list(colors = mypalette),
          pos = FALSE)
```



Pair-wise comparisons

Again, without loss of generality, if we assume that we are interested in intervention $i = 1$, the we wish to calculate

$$p(NB_1 = \max\{NB_i : i \in S\}|k)$$

This can be approximated by the following.

$$\frac{1}{N}\sum_{j}^{N}\prod_{i \in S}\mathbb{I}(k\Delta e_{1,i}^{j} - \Delta c_{1,i}^{j})$$

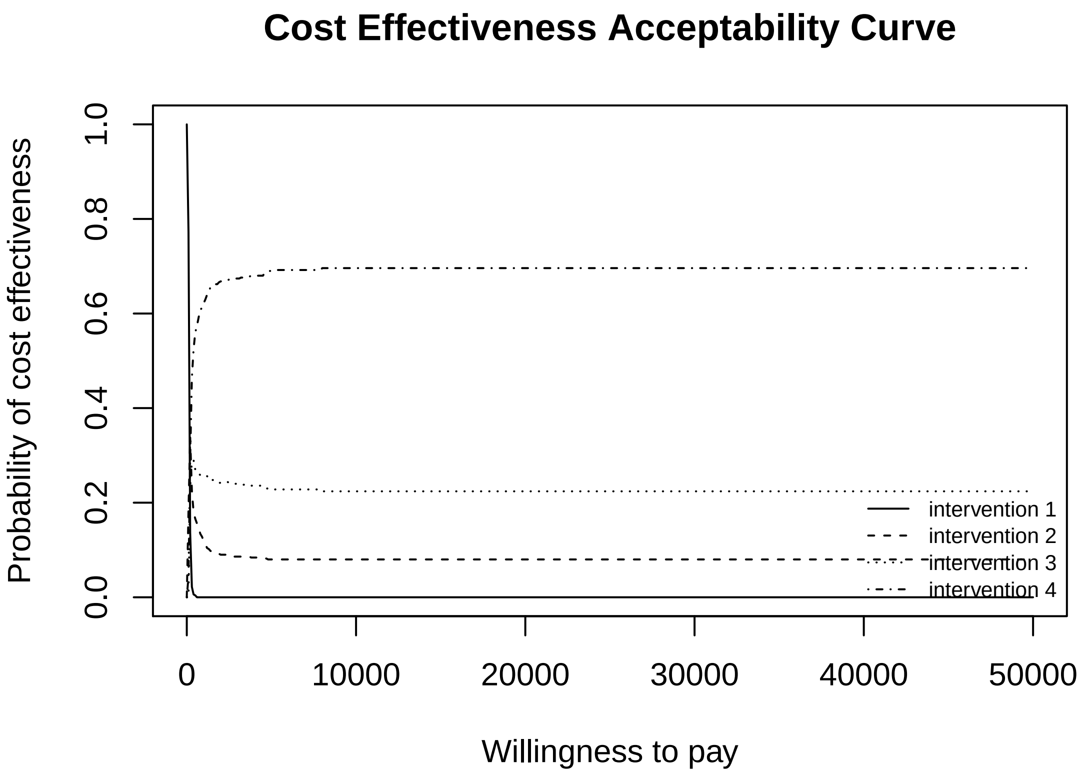
This is then calculated for each $i \in S$.

In BCEA we first we must determine all combinations of paired interventions using the `multi.ce()` function.

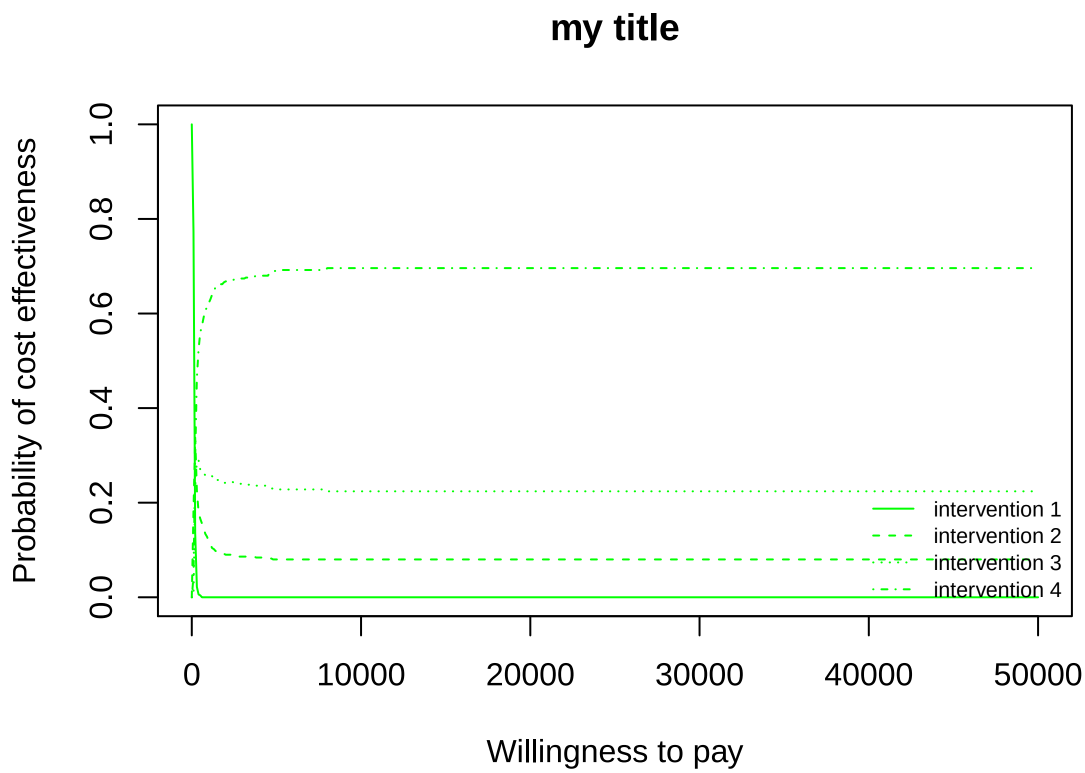
```
he <- multi.ce(he)
```

We can use the same plotting calls as before i.e. `ceac.plot()` and BCEA will deal with the pairwise situation appropriately. Note that in this case the probabilities at a given willingness to pay sum to 1.

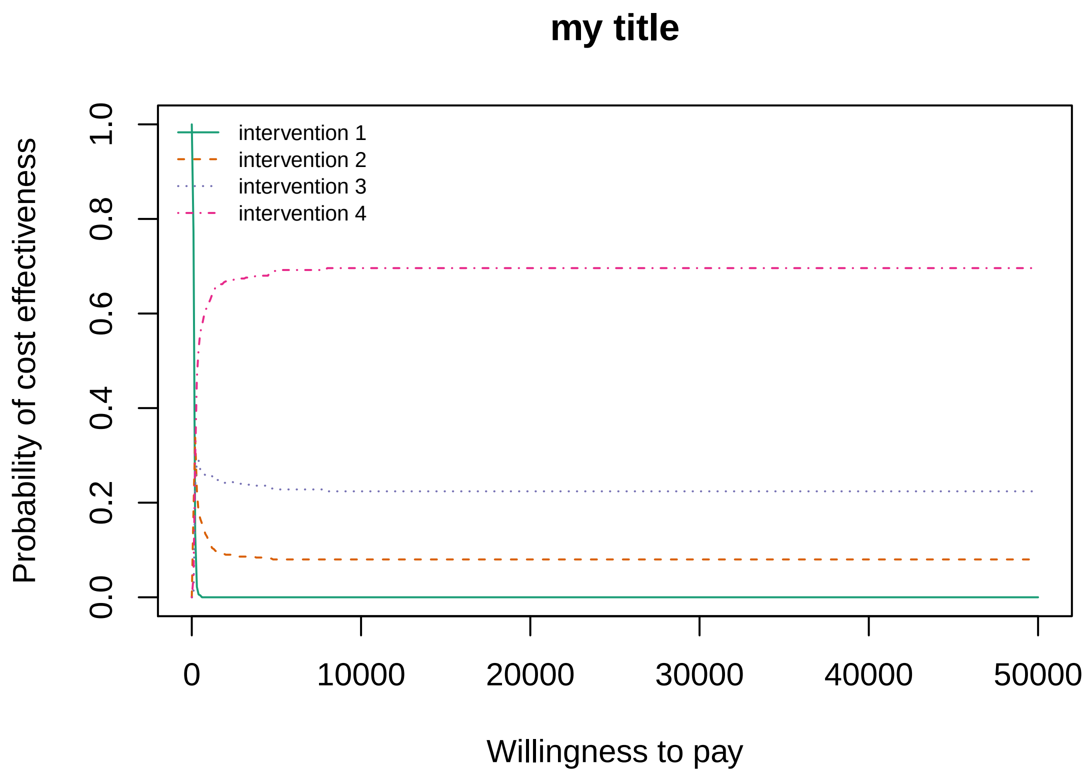
```
ceac.plot(he, graph = "base")
#> Wrong number of colours provided. Falling back to default
```



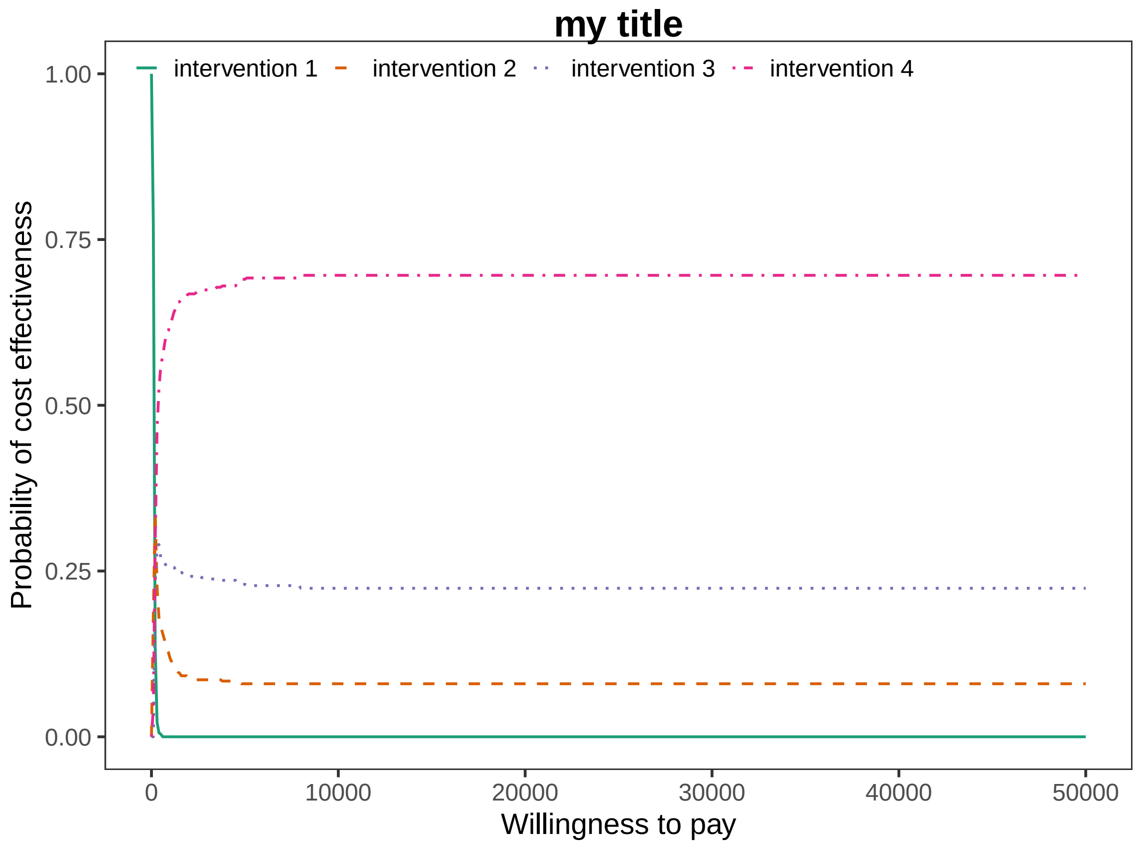

```
ceac.plot(he,
          graph = "base",
          title = "my title",
          line = list(colors = "green"),
          pos = FALSE)
#> Wrong number of colours provided. Falling back to default
```




```
mypalette <- RColorBrewer::brewer.pal(4, "Dark2")

ceac.plot(he,
          graph = "base",
          title = "my title",
          line = list(colors = mypalette),
          pos = c(0,1))
```




```
ceac.plot(he,
          graph = "ggplot2",
          title = "my title",
          line = list(colors = mypalette),
          pos = c(0,1))
```


my title
intervention 1
intervention 2
intervention 3
intervention 4
Probability of cost effectiveness
1.00
0.75
0.50
0.25
0.00
0
10000
20000
30000
40000
50000
Willingness to pay