Cost-effectiveness acceptability curve plots

Introduction

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

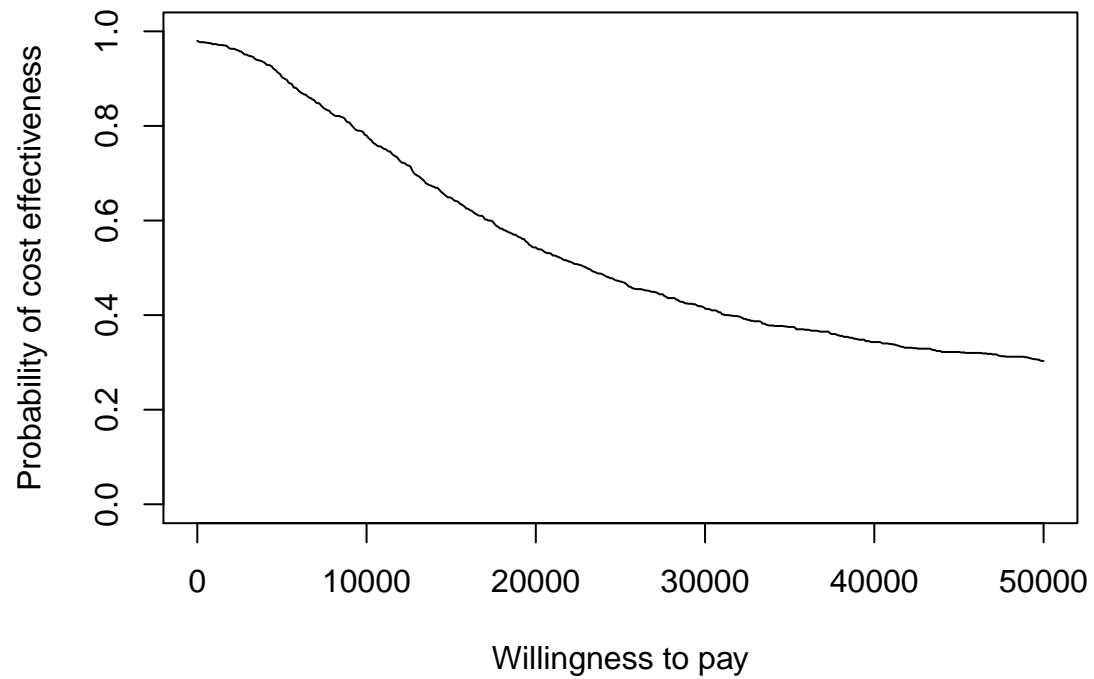$$\frac{1}{N}\sum_j^N \mathbb{I}(k\Delta e^j - \Delta c^j)$$

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

```
data("Vaccine")

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

ceac.plot(he)
```
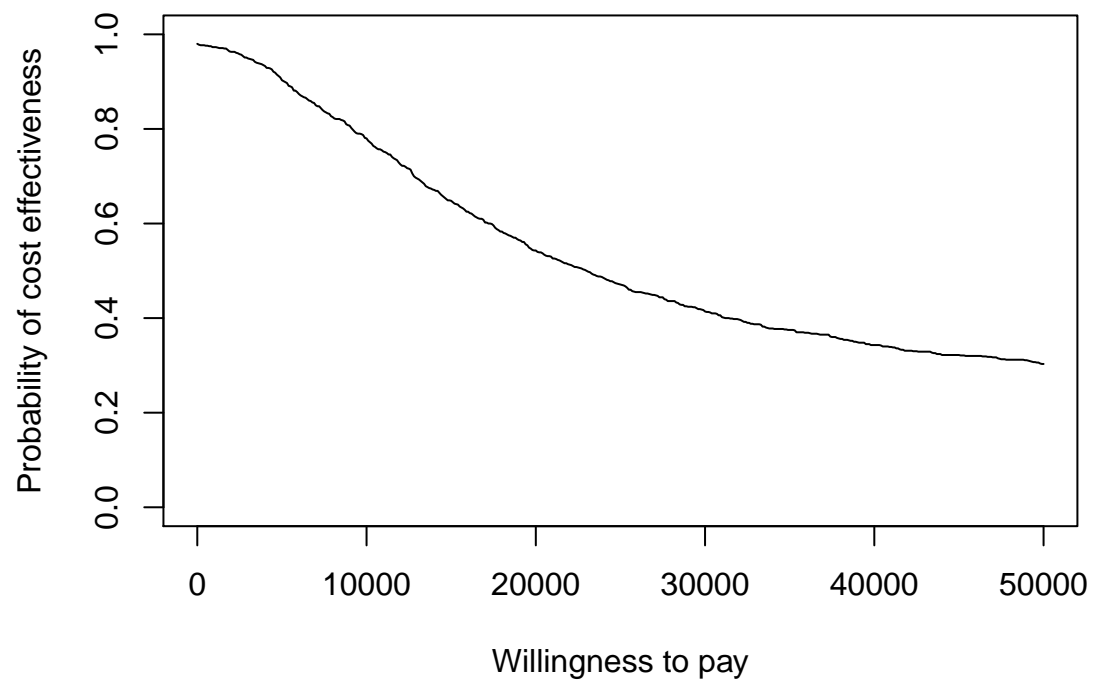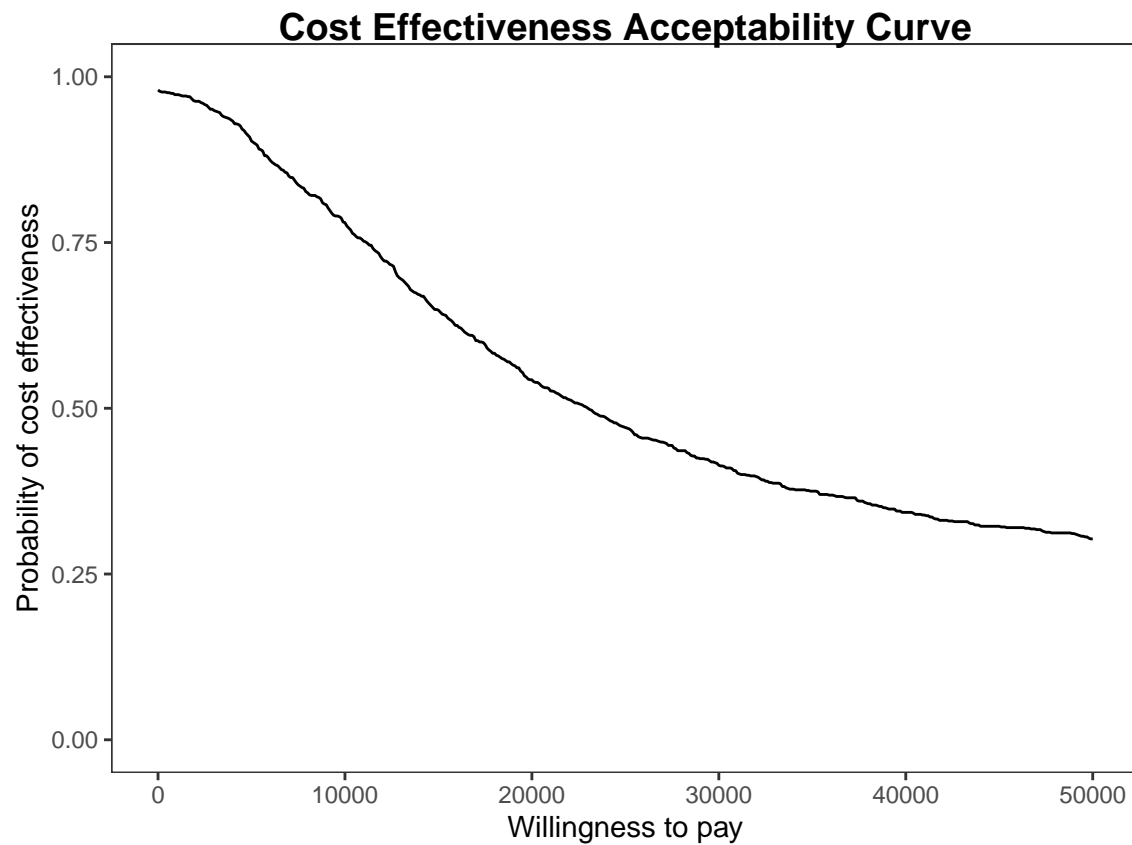
Cost Effectiveness Acceptability Curve

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

```
ceac.plot(he, graph = "base")
```
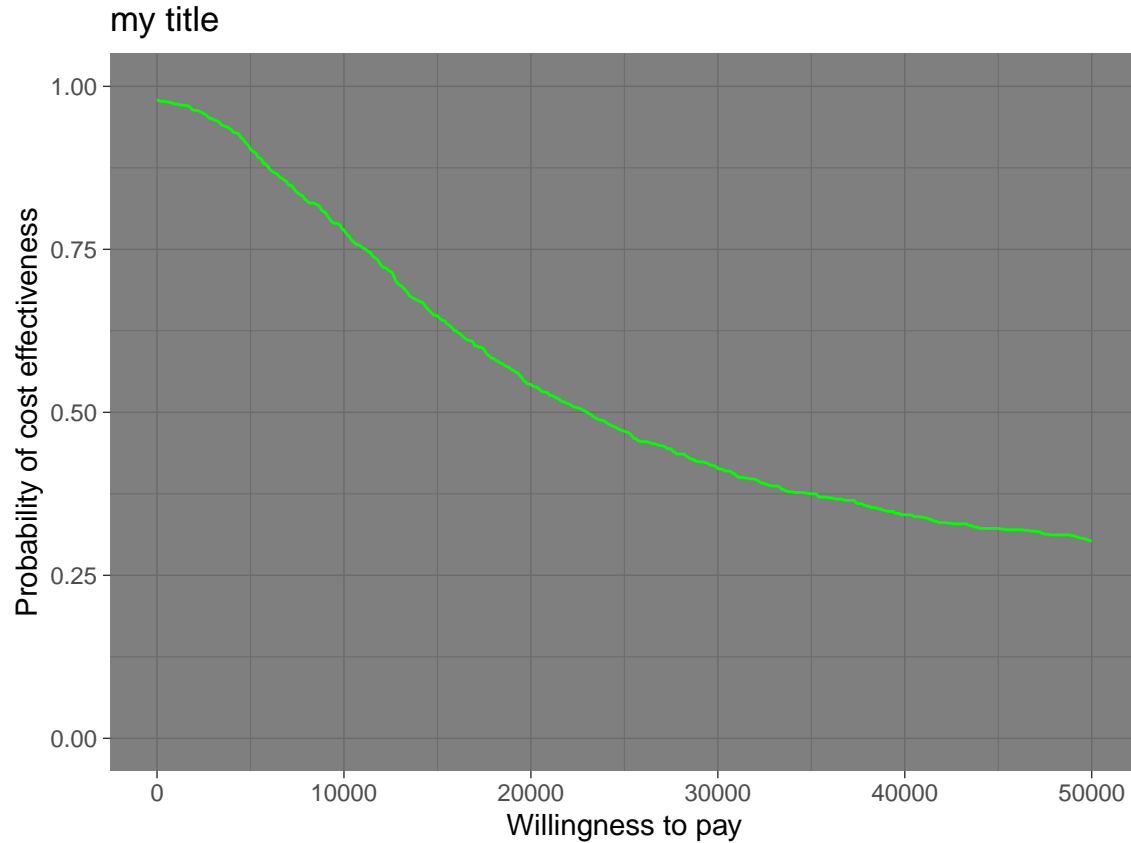
Cost Effectiveness Acceptability Curve


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

Cost Effectiveness Acceptability Curve


```
# 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

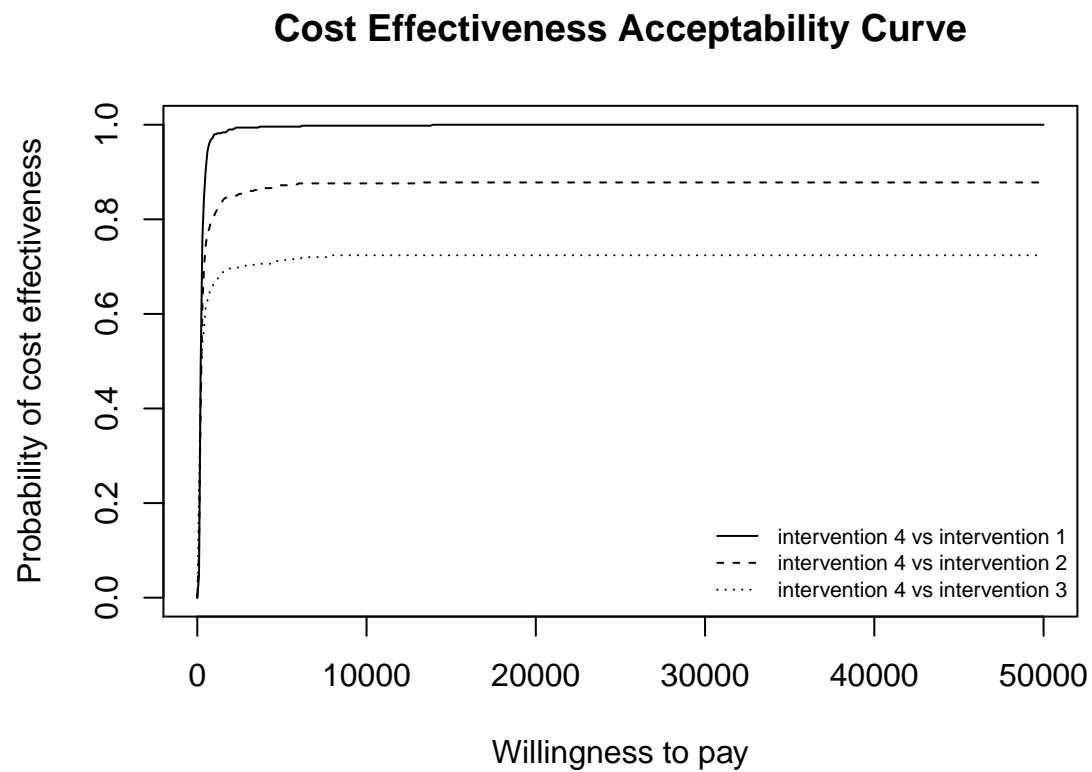$$\frac{1}{N} \sum_j^N \mathbb{I}(k \Delta e_{1,s}^j - \Delta c_{1,s}^j)$$

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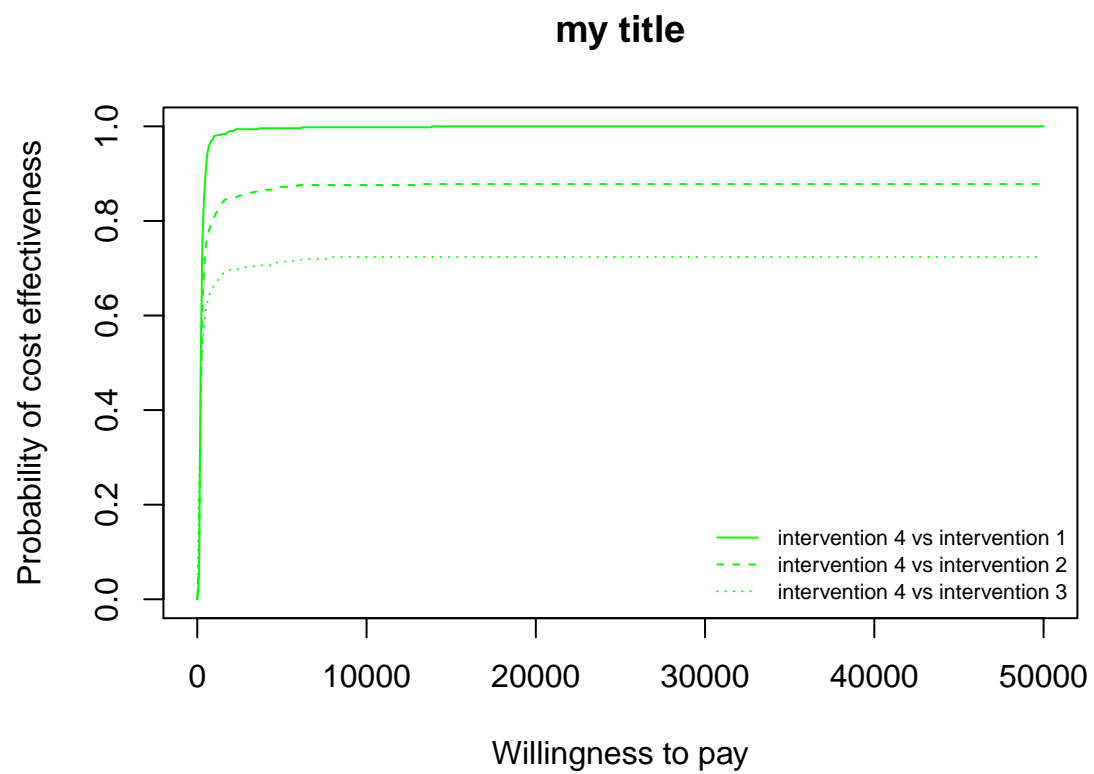
```
data("Smoking")

he <- bcea(e, c, ref = 4)
# str(he)
```
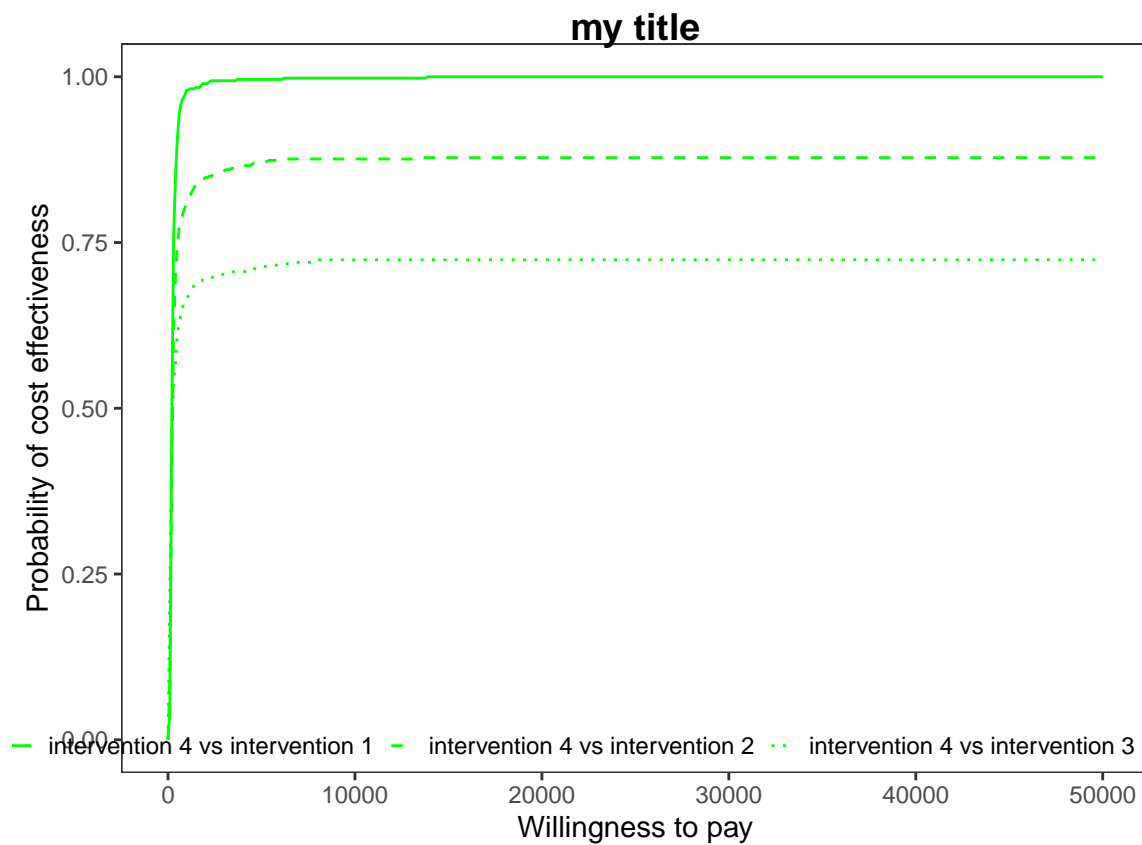
```
ceac.plot(he)
#> Wrong number of colours provided. Falling back to default
```

Cost Effectiveness Acceptability Curve


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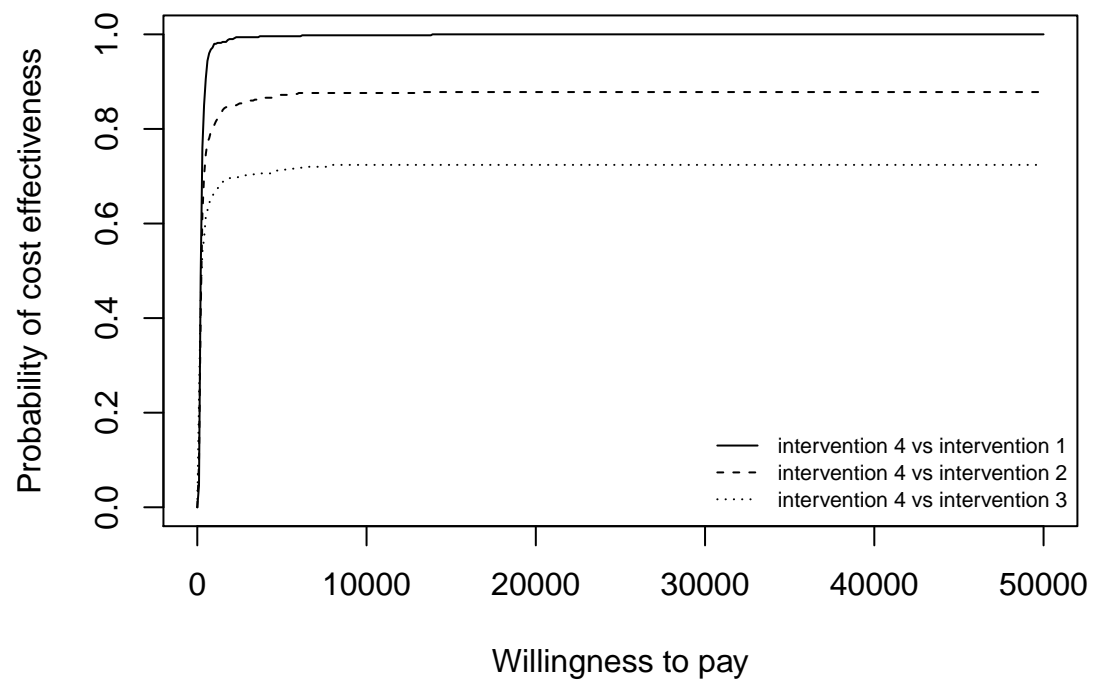
my title


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

Reposition legend.

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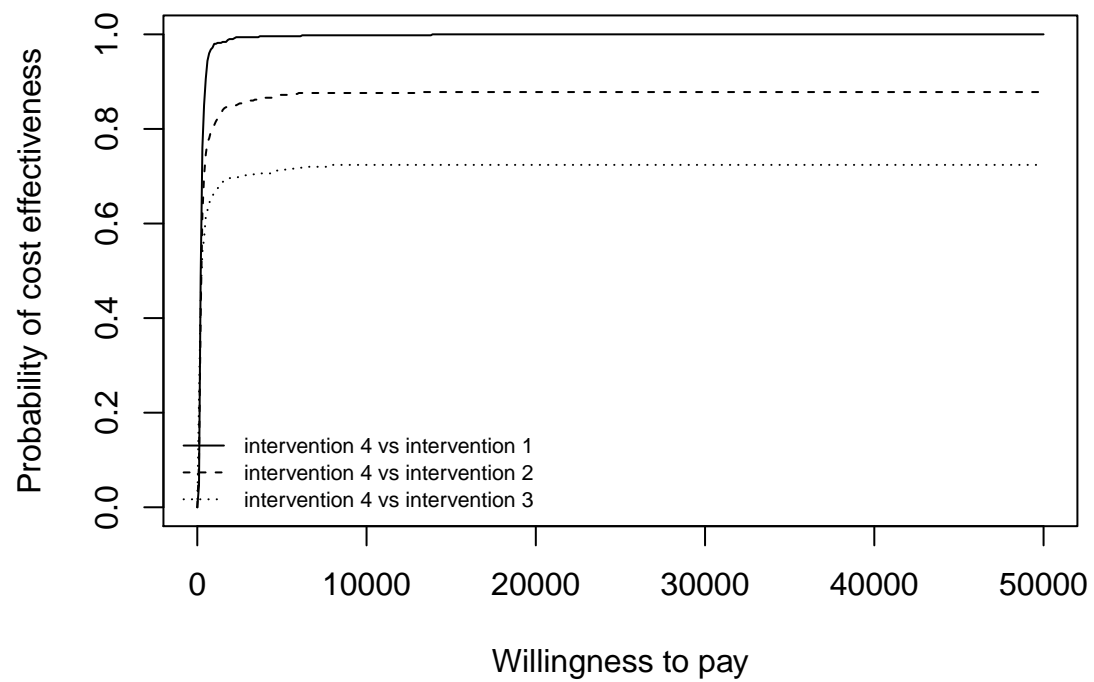
Cost Effectiveness Acceptability Curve

Plot with x-axis "Willingness to pay" (0 to 50000) and y-axis "Probability of cost effectiveness" (0.0 to 1.0).

Legend:
- intervention 4 vs intervention 1
- intervention 4 vs intervention 2
- intervention 4 vs intervention 3

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

Cost Effectiveness Acceptability Curve


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

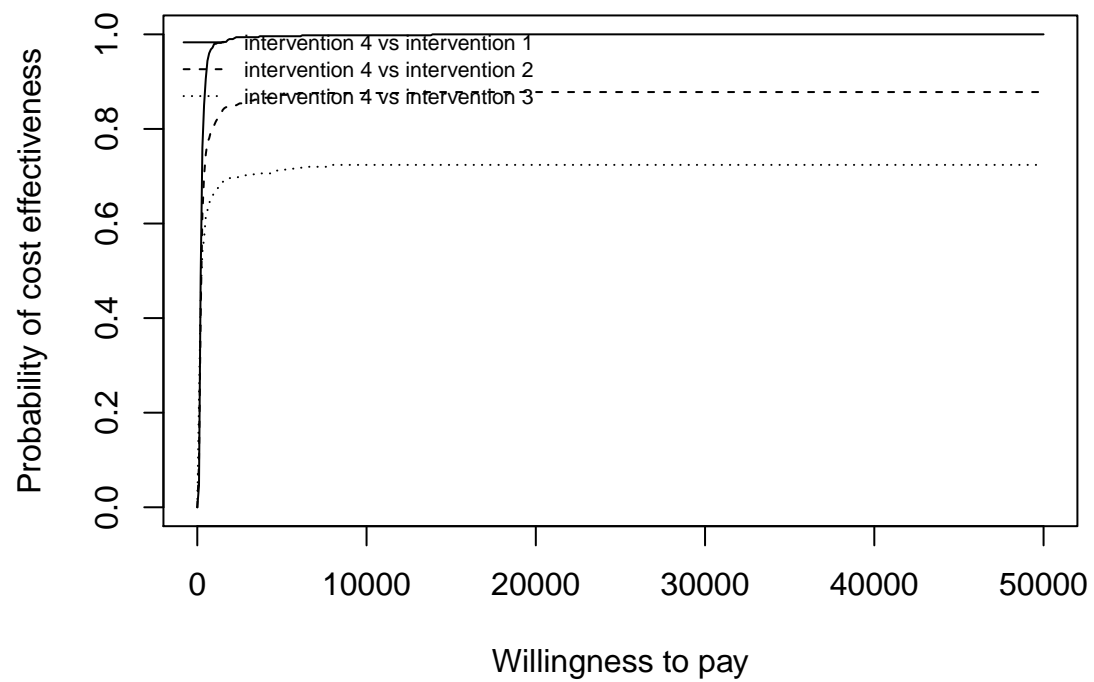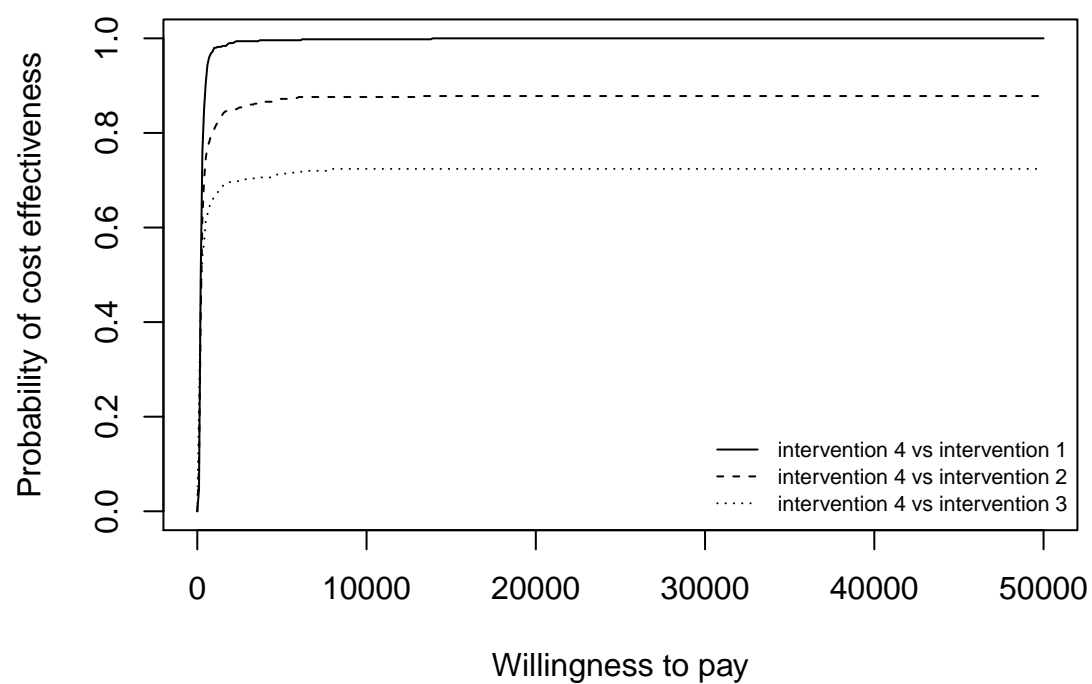**Cost Effectiveness Acceptability Curve**


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

Cost Effectiveness Acceptability Curve


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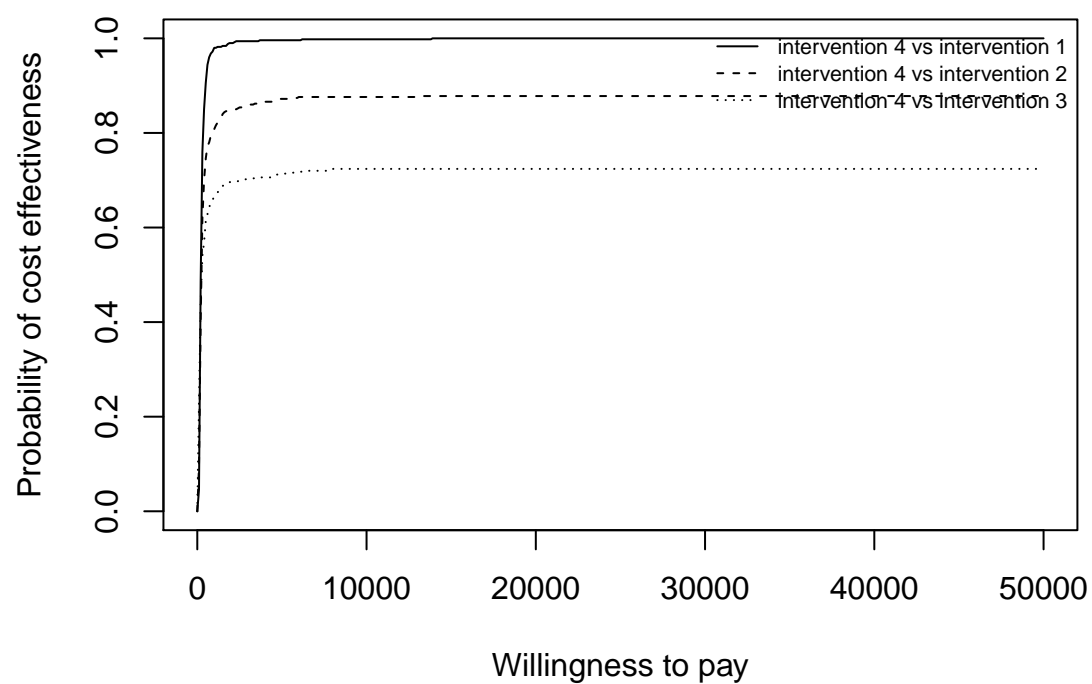
Cost Effectiveness Acceptability Curve

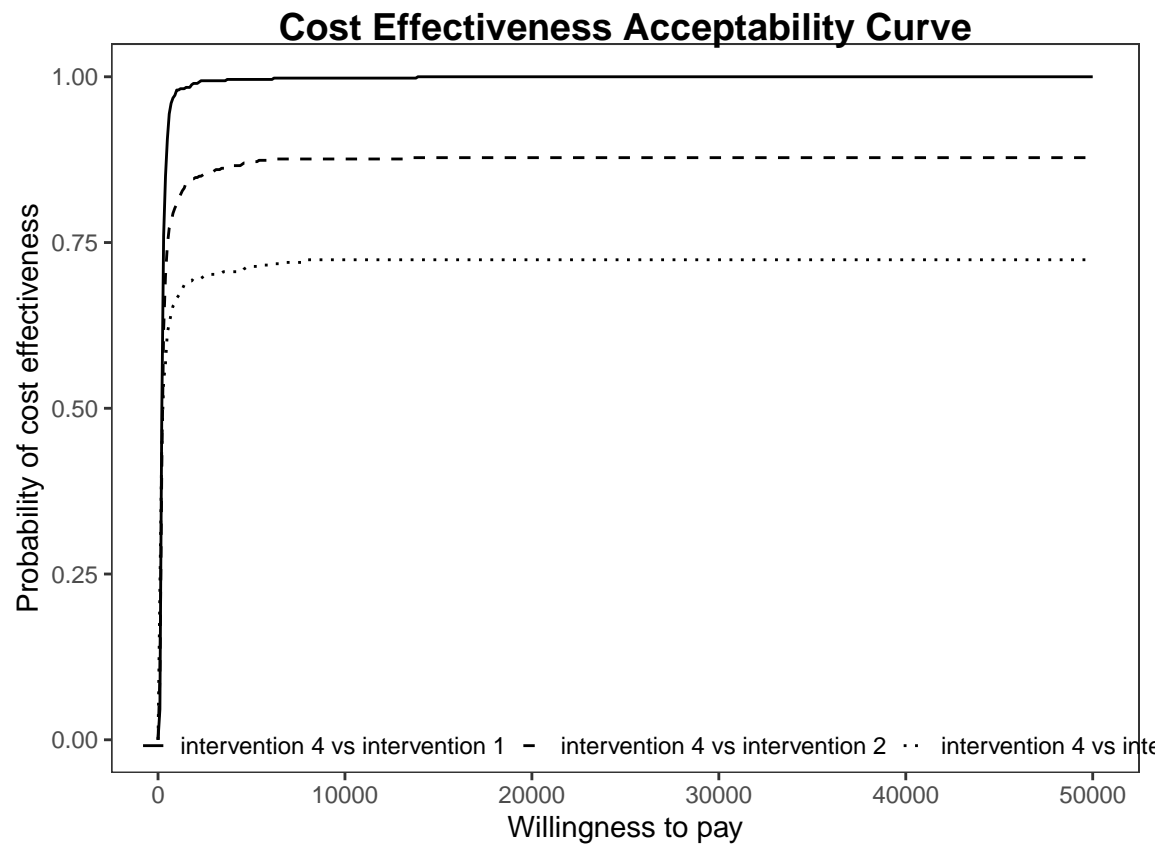

Probability of cost effectiveness (y-axis) vs Willingness to pay (x-axis)

Legend:
- intervention 4 vs intervention 1
- intervention 4 vs intervention 2
- intervention 4 vs intervention 3

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

Cost Effectiveness Acceptability Curve


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

Cost Effectiveness Acceptability Curve

— intervention 4 vs intervention 1 = intervention 4 vs intervention 2 ·· intervention 4 vs inte

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

Cost Effectiveness Acceptability Curve


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

Cost Effectiveness Acceptability Curve

intervention 4 vs intervention 1   — intervention 4 vs intervention 2 ·· intervention 4 vs intervention 3

Probability of cost effectiveness

Willingness to pay

Define colour palette.

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

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

my title

Probability of cost effectiveness

intervention 4 vs intervention 1
intervention 4 vs intervention 2
intervention 4 vs intervention 3

Willingness to pay
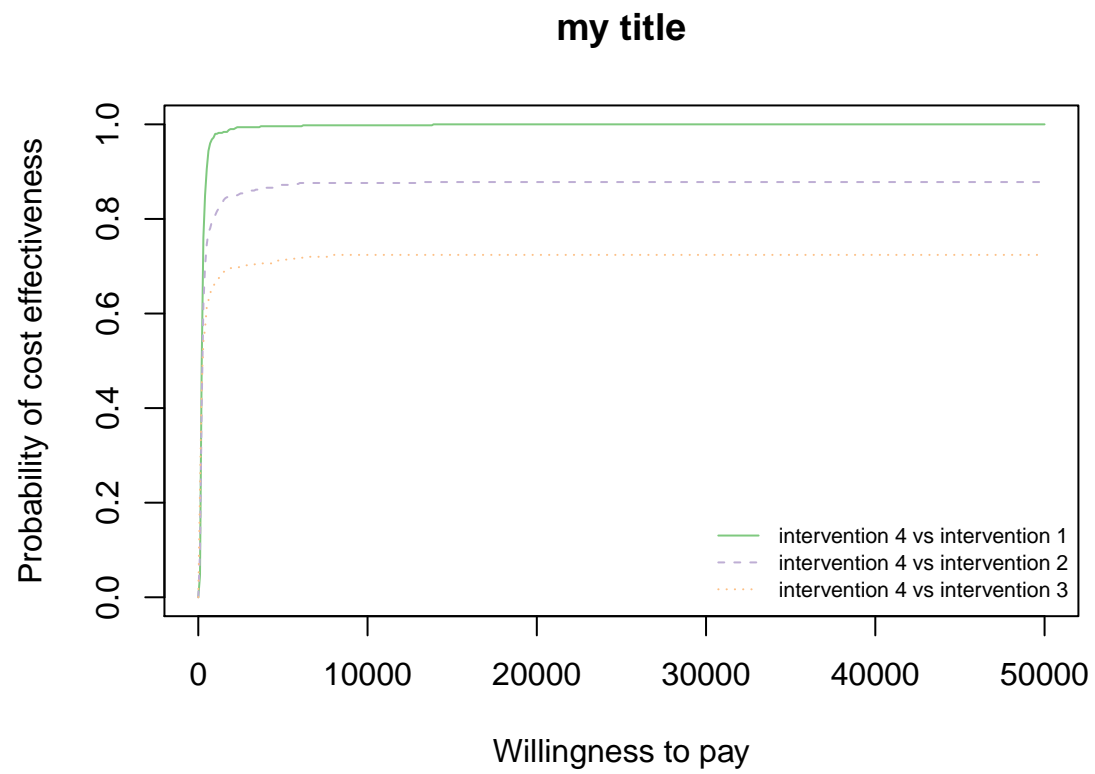
```r
ceac.plot(he,
          graph = "ggplot2",
          title = "my title",
          line = list(colors = mypalette),
          pos = FALSE)
```
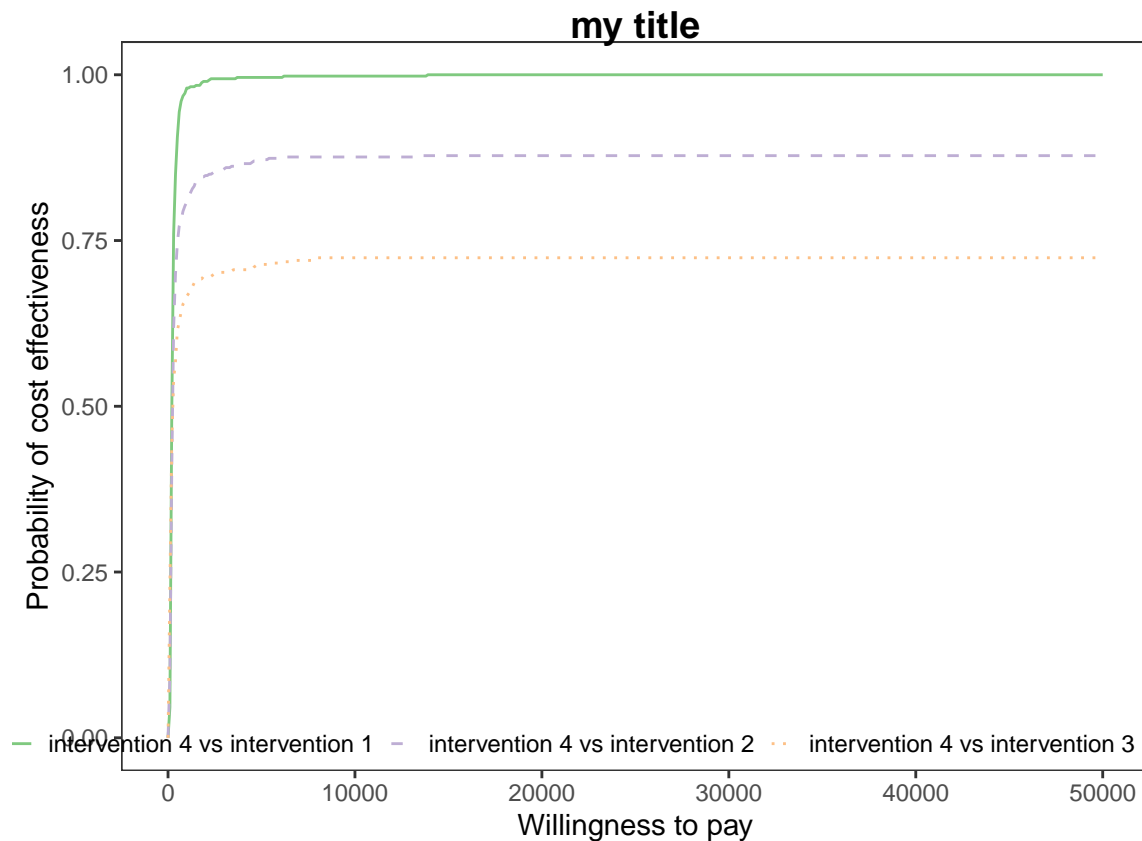
Pair-wise comparisons

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.

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

R code 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
```

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Cost Effectiveness Acceptability Curve
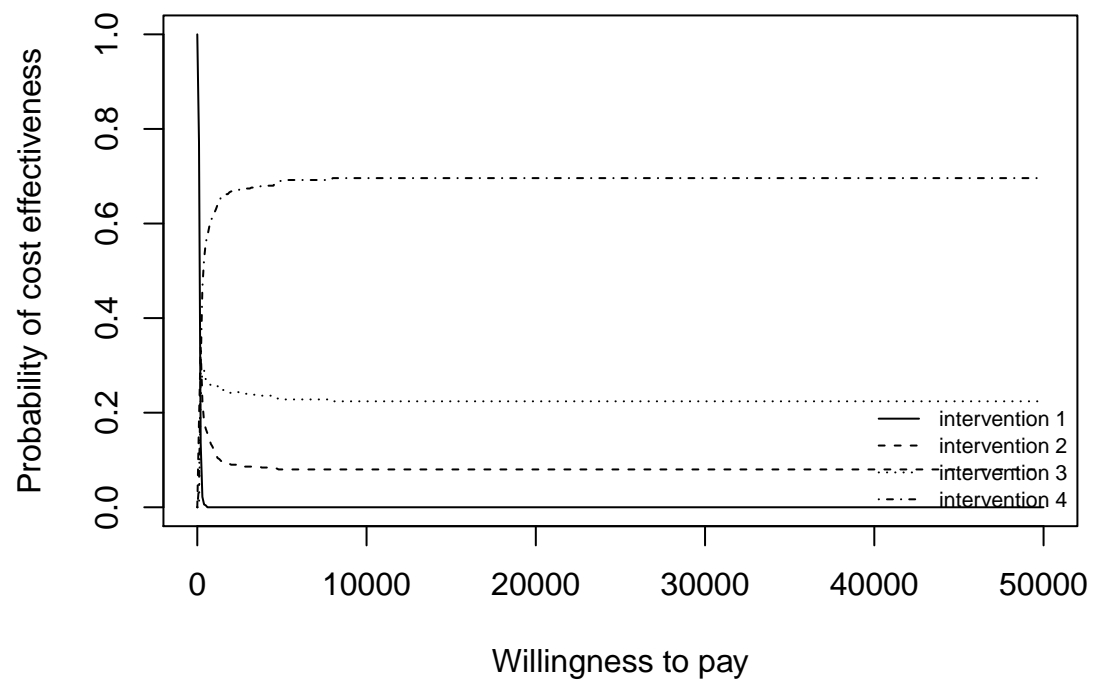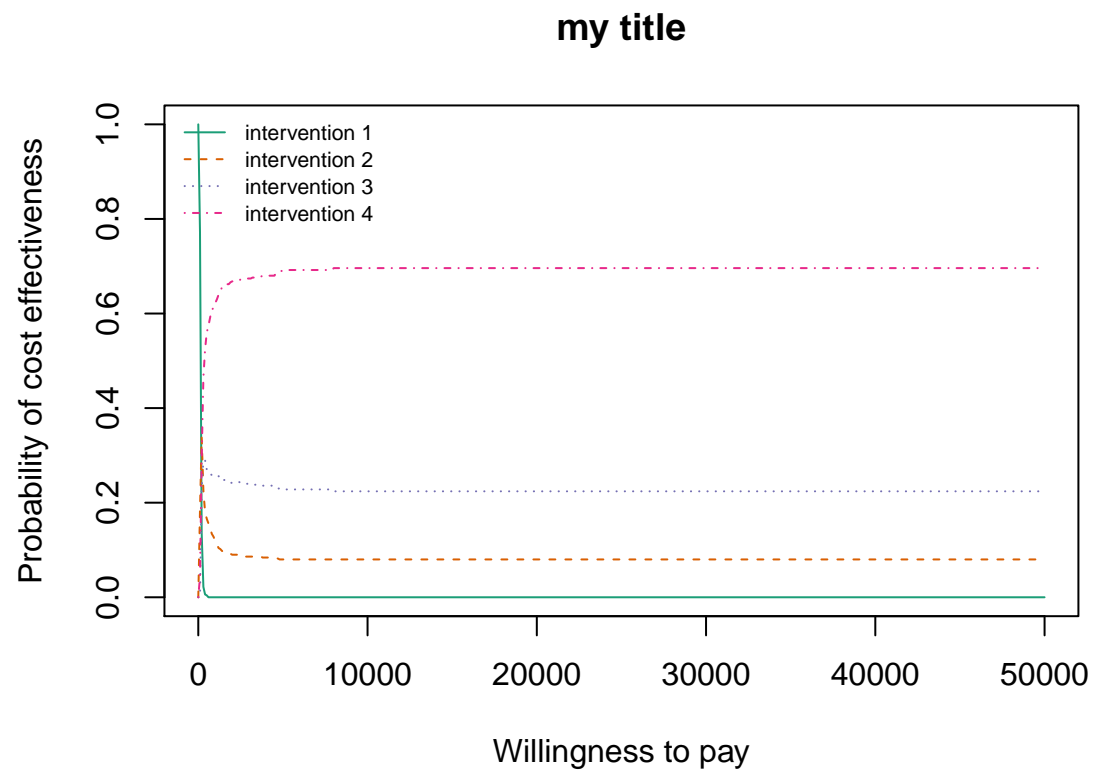


```
ceac.plot(he,
          graph = "base",
          title = "my title",
          line = list(colors = "green"),
          pos = FALSE)
#> Wrong number of colours provided. Falling back to default
```

my title

Probability of cost effectiveness vs Willingness to pay

intervention 1
intervention 2
intervention 3
intervention 4
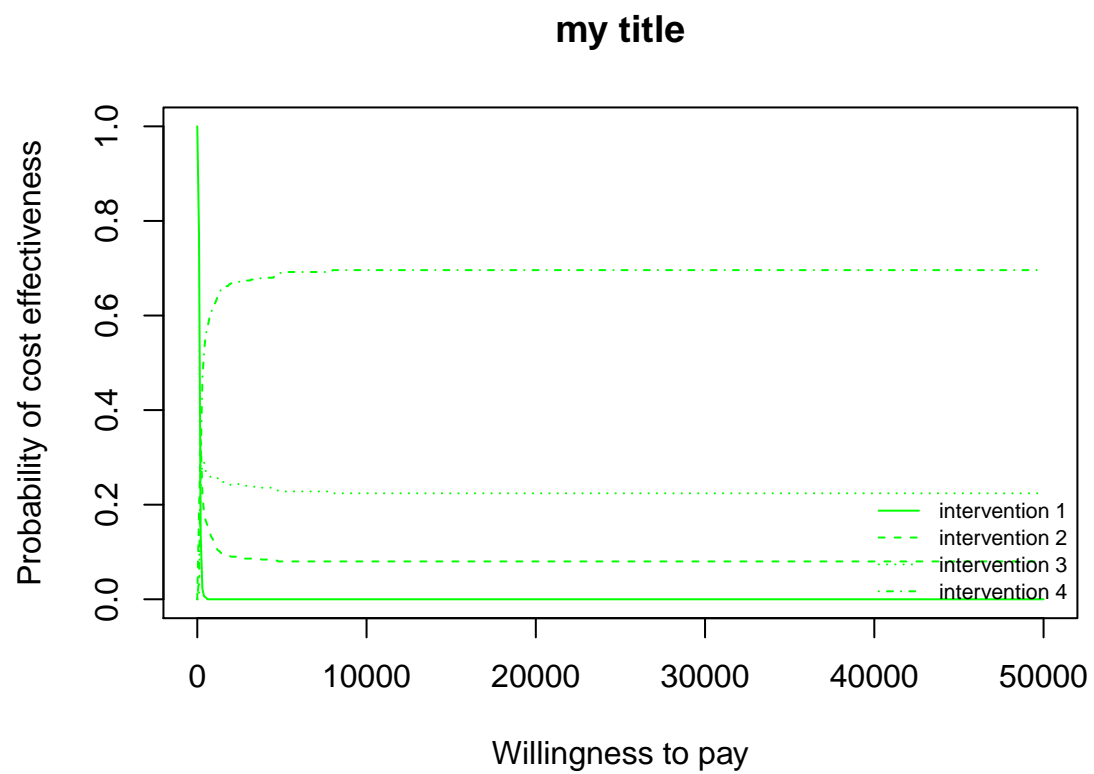
```r
mypalette <- RColorBrewer::brewer.pal(4, "Dark2")

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

my title


```
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