

```
R> library("interval")
R> data("bcos", package = "interval")
R> head(bcos)
```

# STAT 222 Week 8

## Interval Censoring (mash-up)

```
left right treatment
1 45 Inf Rad
2 6 10 Rad
3 0 7 Rad
4 46 Inf Rad
5 46 Inf Rad
6 7 16 Rad
```

We demonstrate the two main functions in interval, icfit and ictest, with the commonly used interval-censored breast cosmesis data set of Finkelstein and Wolfe (1985). The data are from a study of two groups of breast cancer patients, those treated with radiation therapy with chemotherapy (treatment = "RadChem") and those treated with radiation therapy alone (treatment = "Rad"). The response is time (in months) until the appearance of breast retraction, and the data are interval-censored between the last clinic visit before the event was observed (left) and the first visit when the event was observed (right) (or Inf if the event was not observed). The following provides the first few observations of the data set.

### 4.1. Survival estimation

First, we calculate the NPMLE for each treatment group in the breast cosmesis data separately.

```
R> fit1 <- icfit(Surv(left, right, type = "interval2") ~ treatment,
+ data = bcos)
R> summary(fit1)
```

```
treatment=Rad:
Interval Probability
1 (4,5] 0.0463
2 (6,7] 0.0334
3 (7,8] 0.0887
4 (11,12] 0.0708
5 (24,25] 0.0926
6 (33,34] 0.0818
7 (38,40] 0.1209
8 (46,48] 0.4656

treatment=RadChem:
Interval Probability
1 (4,5] 0.0433
2 (5,8] 0.0433
3 (11,12] 0.0692
4 (16,17] 0.1454
5 (18,19] 0.1411
6 (19,20] 0.1157
7 (24,25] 0.0999
8 (30,31] 0.0709
9 (35,36] 0.1608
10 (44,48] 0.0552
11 (48,60] 0.0552
```

*cg KM*

*From Fay + Shaw  
JSS 2010 36(2)  
(linked on page)*

data. The default method is the permutation test, and since the sample size is sufficiently large we automatically get the version based on the permutational central limit theorem:

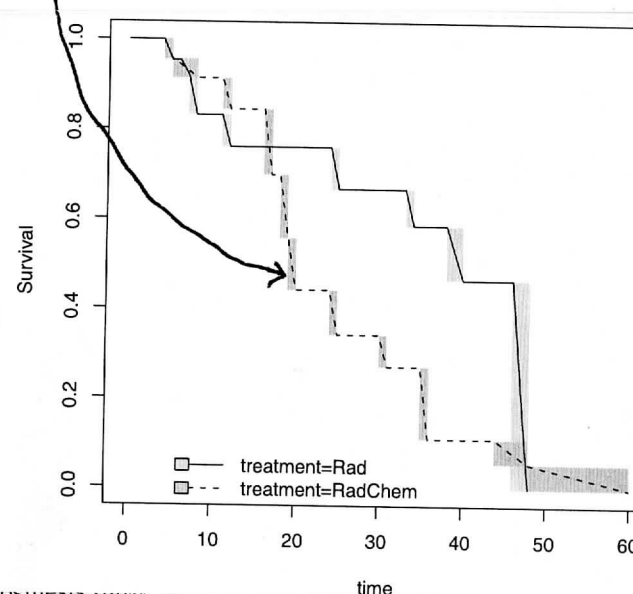
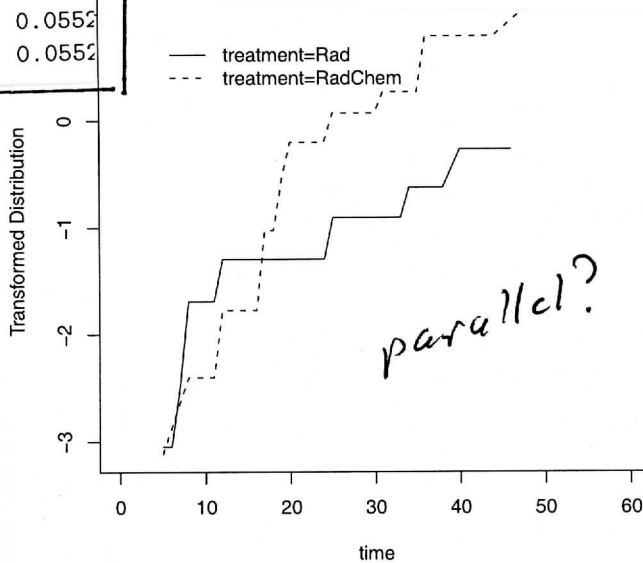
```
R> icout <- ictest(Surv(left, right, type = "interval2") ~ treatment,
+ data = bcos)
R> icout
```

Asymptotic Logrank two-sample test (permutation form),  
Sun's scores

data: Surv(left, right, type = "interval2") by treatment  
Z = -2.6684, p-value = 0.007622  
alternative hypothesis: survival distributions not equal

```
n Score Statistic*
treatment=Rad 46 -9.141846
treatment=RadChem 48 9.141846
* like Obs-Exp, positive implies earlier failures than expected
```

*Survival does  
parametric  
hazard version*



*can do exact  
permutation*

Figure 2: Complementary log-log transformation of distribution from breast cosmesis data. If parallel then proportional hazards is a good model.

```

> source("http://bioconductor.org/biocLite.R")
> biocLite("Icens")
Installing package(s) 'Icens'
package 'Icens' successfully unpacked and MD5 sums checked
> library(Icens) > library(interval)
Loading required package: MLEcens
> data(bcos)
> head(bcos)
  left right treatment
1   45   Inf      Rad
2    6    10      Rad
3    0     7      Rad
4   46   Inf      Rad
5   46   Inf      Rad
6    7    16      Rad
> tail(bcos)
  left right treatment
89   18    24 RadChem
90   16    60 RadChem
91   35    39 RadChem
92   21   Inf RadChem
93   11    20 RadChem
94   48   Inf RadChem
> fit<-icfit(Surv(left,right,type="interval2")~treatment, data=bcos)
> summary(fit)
treatment=Rad:
  Interval Probability
1   (4,5]    0.0463
2   (6,7]    0.0334
3   (7,8]    0.0887
4  (11,12]   0.0708
5  (24,25]   0.0926
6  (33,34]   0.0818
7  (38,40]   0.1209
8  (46,48]   0.4656
treatment=RadChem:
  Interval Probability
1   (4,5]    0.0433
2   (5,8]    0.0433
3  (11,12]   0.0692
4  (16,17]   0.1454
5  (18,19]   0.1411
6  (19,20]   0.1157
7  (24,25]   0.0999
8  (30,31]   0.0709
9  (35,36]   0.1608
10 (44,48]   0.0552
11 (48,60]   0.0552

> plot(fit) #shading or not (RadChem bad)
> plot(fit, dtype = "link") #does cloglog, Fig 2

> test<-ictest(Surv(left,right,type="interval2")~treatment,data=bcos)
> test
  Asymptotic Logrank two-sample test (permutation form), Sun's scores
data: Surv(left, right, type = "interval2") by treatment
Z = -2.6684, p-value = 0.007622
alternative hypothesis: survival distributions not equal
      n Score Statistic*
treatment=Rad      46      -9.141846
treatment=RadChem 48       9.141846
* like Obs-Exp, positive implies earlier failures than expected

> ictest(Surv(left,right,type="interval2")~treatment,data=bcos, scores="wmw", exact=TRU)
  Exact Wilcoxon two-sample test (permutation form)
data: Surv(left, right, type = "interval2") by treatment
p-value = 0.026
alternative hypothesis: survival distributions not equal
      n Score Statistic*
treatment=Rad      46      -5.656724
treatment=RadChem 48       5.656724
* like Obs-Exp, positive implies earlier failures than expected
p-value estimated from 999 Monte Carlo replications
99 percent confidence interval on p-value:
  0.009926283 0.048044749

```