Log Rank Test of Ulcer Survival

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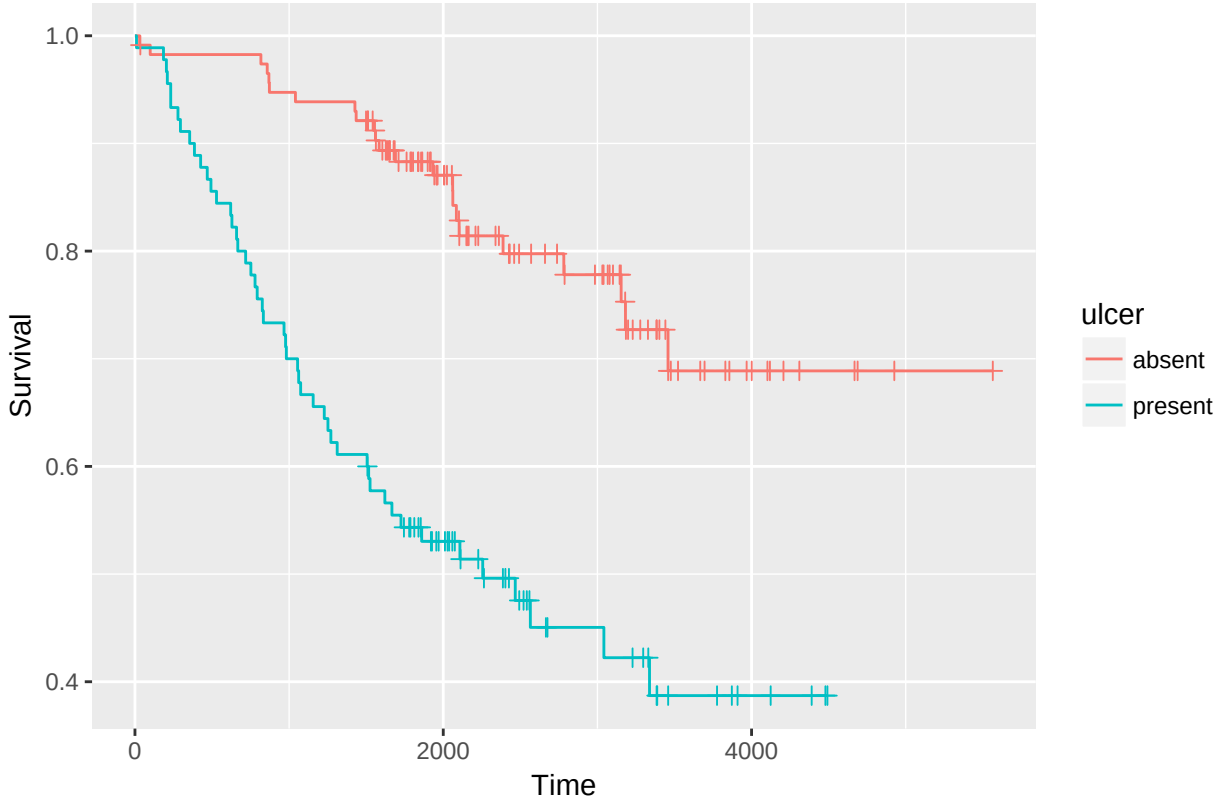
We have survival data on 205 patients. We are interested in investigating the effects of tumor presence on survival rate.

We can visualize our survival data by creating Kaplan-Meier curves for all causes of death for patients with ulcers versus those without. Further, we can perform a log-rank test to test if there are significant differences in time to mortality between the two groups.

```
mel <- Melanoma
mel[["ulcer"]] <- factor(mel[["ulcer"]], levels = 0:1, labels = c("absent",
    "present"))
```

Let's plot the Kapplan-Meier estimated survival curve using both causes of death (either melanoma or other) and stratified by presence of ulcer.

```
ggsurv(survfit(Surv(time, Melanoma$status == 3 | Melanoma$status ==
    1) ~ ulcer, data = mel))
```



Clearly there is a difference - probability of survival is dramatically lower for those with an ulcer versus those without at all time points except the first few. We would expect a statistical test to find a significant difference in time to mortality between the two groups.

Let's conduct a log-rank test between the two groups.

```
# when the rho argument is set to zero, this is the log-rank
# test.
survdiff(Surv(time, Melanoma$status == 3 | Melanoma$status ==
```

```
    1) ~ ulcer, data = mel, rho = 0)
```

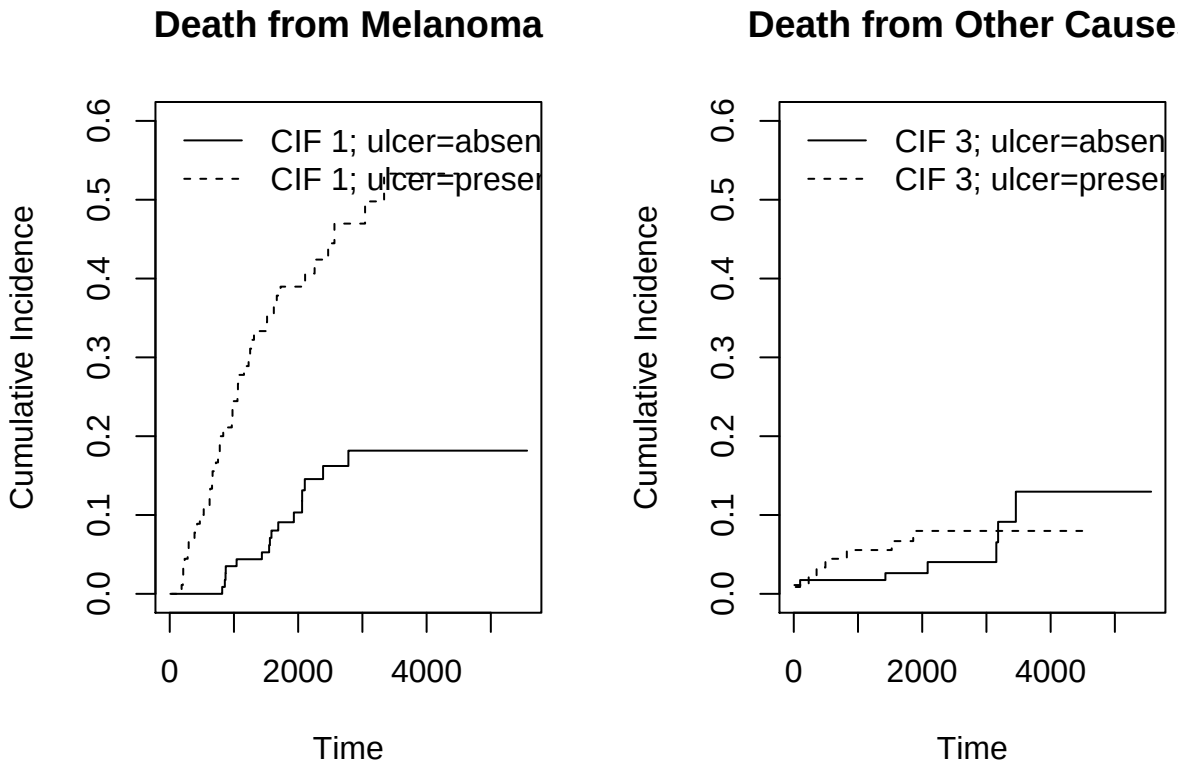
```
## Call:
## survdiff(formula = Surv(time, Melanoma$status == 3 | Melanoma$status ==
##     1) ~ ulcer, data = mel, rho = 0)
##
##                 N Observed Expected (O-E)^2/E (O-E)^2/V
## ulcer=absent  115       23     44.5      10.4      27.9
## ulcer=present  90       48     26.5      17.3      27.9
##
##  Chisq= 27.9  on 1 degrees of freedom, p= 1.3e-07
```

The test vindicates our suspicion - that there is a difference between the two groups. Assuming an alpha level of .05, our p-value is nowhere close to exceeding our alpha. This means that the probability of getting this effect in our data (or a more extreme effect) just by random chance is so exceedingly small that we're comfortable with saying that this isn't random chance - presence of ulcer is associated with a decreased time to mortality.

Now let's take a look at the relationship between cause of death, ucler status, and survival.

Now we create two cumulative incidence curves - one for those dying of melanoma and one for those dying of other causes. In each graph, we overlay a curve for patients with ulcers by one for the nonulcer patients.

```
# dying of melanoma\
require(etm)
cif.mel <- etmCIF(Surv(time, status != 2) ~ ulcer, data = mel,
    etype = status)
par(mfrow = c(1, 2))
plot(cif.mel, which.cif = 1, ylim = c(0, 0.6), main = "Death from Melanoma")
plot(cif.mel, which.cif = 3, ylim = c(0, 0.6), main = "Death from Other Causes")
```



There is a clear difference in the effect of ulcers between those whoe died from Melanoma and those who

died from other causes. Misappropriating the terms from ANOVA, there is a main effect for ulcer when we ignore the type of death once we account for type of death, we see an interaction effect: the effect of ulcers on time-to-death are different for those dying from melanoma and those dying from something else. There is a clear, negative effect of ulcer for those with melanoma. There is little to no effect for those who died from something else.