HW9_answer

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Problem 1. Determine the survival and density function

Notate survival function as $S(x)$, cumulative hazard function as $H(x)$, cumulative density function as $F(x)$ and probability density function as $f(x)$:

$$h(x) = \frac{2x}{1 + x^2}$$

$$H(x) = \int_0^x h(t)dt = ln(1 + x^2)$$

$$S(x) = exp(-H(x)) = \frac{1}{1 + x^2}$$

$$F(x) = 1 - S(x) = 1 - \frac{1}{1 + x^2}$$

$$f(x) = \frac{d}{dx}F(x) = \frac{2x}{(1 + x^2)^2}$$

Problem 2. Write out table and calculate estimation of survival function

t_i	n_i	d_i	c_i	$\hat{\lambda}_i$	$\hat{S}(t)$	$\tilde{H}(t)$	$exp(-\tilde{H}(t))$
1	10	1	0	$\frac{1}{10}$	$1 * (1 - \frac{1}{10}) = \frac{9}{10}$	$\frac{1}{10}$	0.905
2	9	2	0	$\frac{2}{9}$	$\frac{9}{10} * (1 - \frac{2}{9}) = \frac{7}{10}$	$\frac{1}{10} + \frac{2}{9} = \frac{29}{90}$	0.725
4	7	0	1	0	$\frac{7}{10}$	$\frac{29}{90}$	0.725
5	6	0	1	0	$\frac{7}{10}$	$\frac{29}{90}$	0.725
6	5	1	0	$\frac{1}{5}$	$\frac{7}{10} * (1 - \frac{1}{5}) = \frac{14}{25}$	$\frac{29}{90} + \frac{1}{5} = \frac{47}{90}$	0.593
7	4	0	1	0	$\frac{14}{25}$	$\frac{47}{90}$	0.593
8	3	0	1	0	$\frac{14}{25}$	$\frac{47}{90}$	0.593
9	2	0	1	0	$\frac{14}{25}$	$\frac{47}{90}$	0.593
10	1	0	1	0	$\frac{14}{25}$	$\frac{47}{90}$	0.593

Problem 3. Tongue data

Figure: KM curve for each tumor type
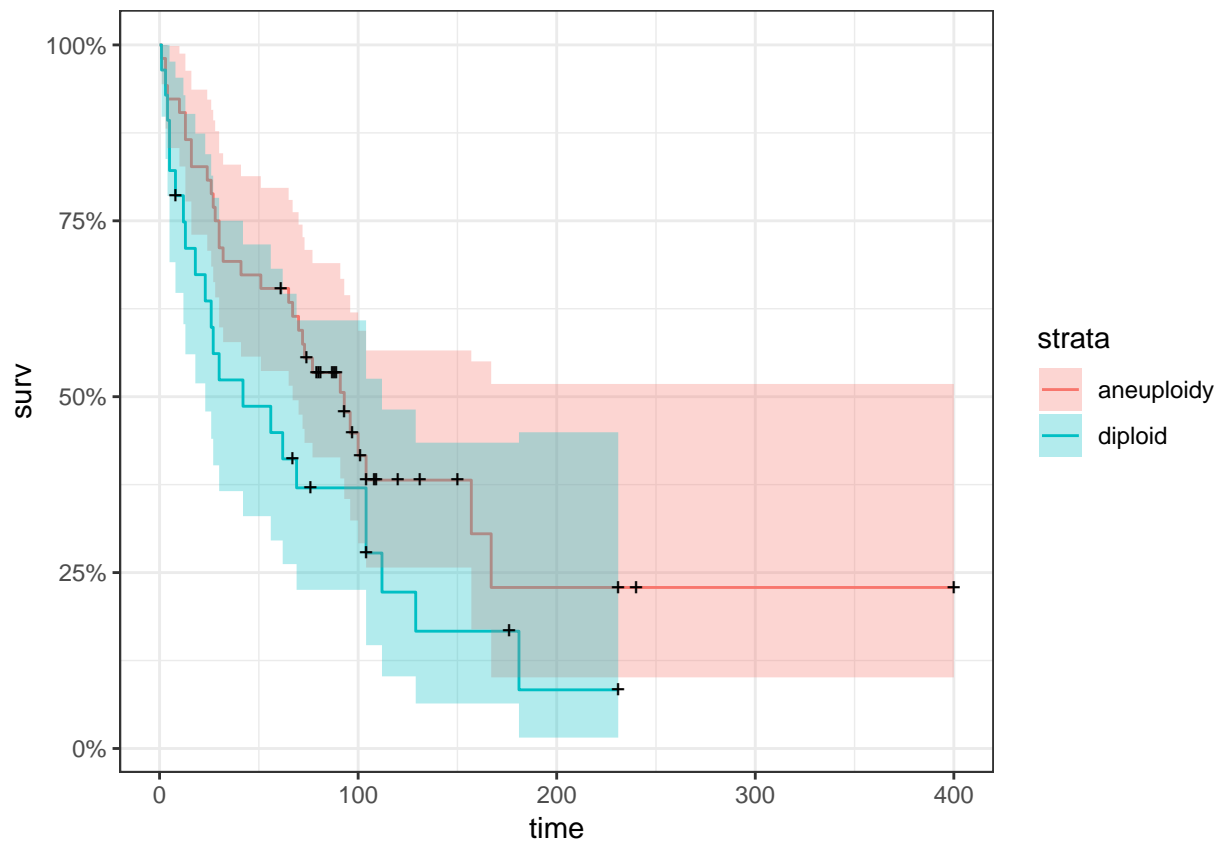
Table: estimated 1-year survival rate and 95% CI

	lower bond	estimate	upper bond
aneuploidy	0.5365233	0.6538462	0.7968243
diploid	0.3302132	0.4863946	0.7164452

Code

```r
knitr::opts_chunk$set(echo = F,
                      message = F,
                      warning = F,
                      comment = "")
library(tidyverse)
library(KMsurv)
library(survival)
library(ggfortify)
theme_set(theme_bw())
data("tongue")
tongue = tongue %>%
  mutate(type = ifelse(type == 1, "aneuploidy", "diploid"))

# plot
fit <- survfit(Surv(time, delta) ~ type, data = tongue)
autoplot(fit)
# prediction
```

```r
tmp = summary(fit, time = 365/7)
output = t(rbind(tmp$lower, tmp$surv, tmp$upper))
rownames(output) = c("aneuploidy", "diploid")
colnames(output) = c("lower bond", "estimate", "upper bond")
output %>% knitr::kable()
```