



SURVIVAL ANALYSIS IN R

The Cox Model

Heidi Seibold

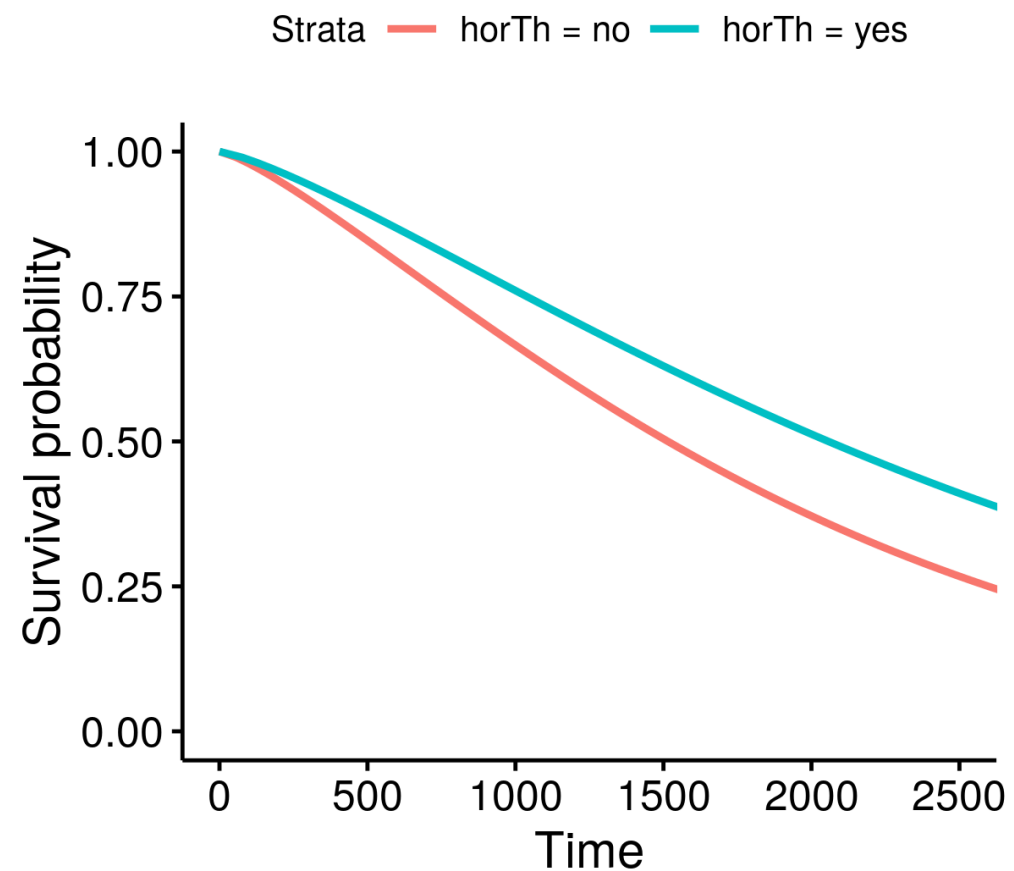
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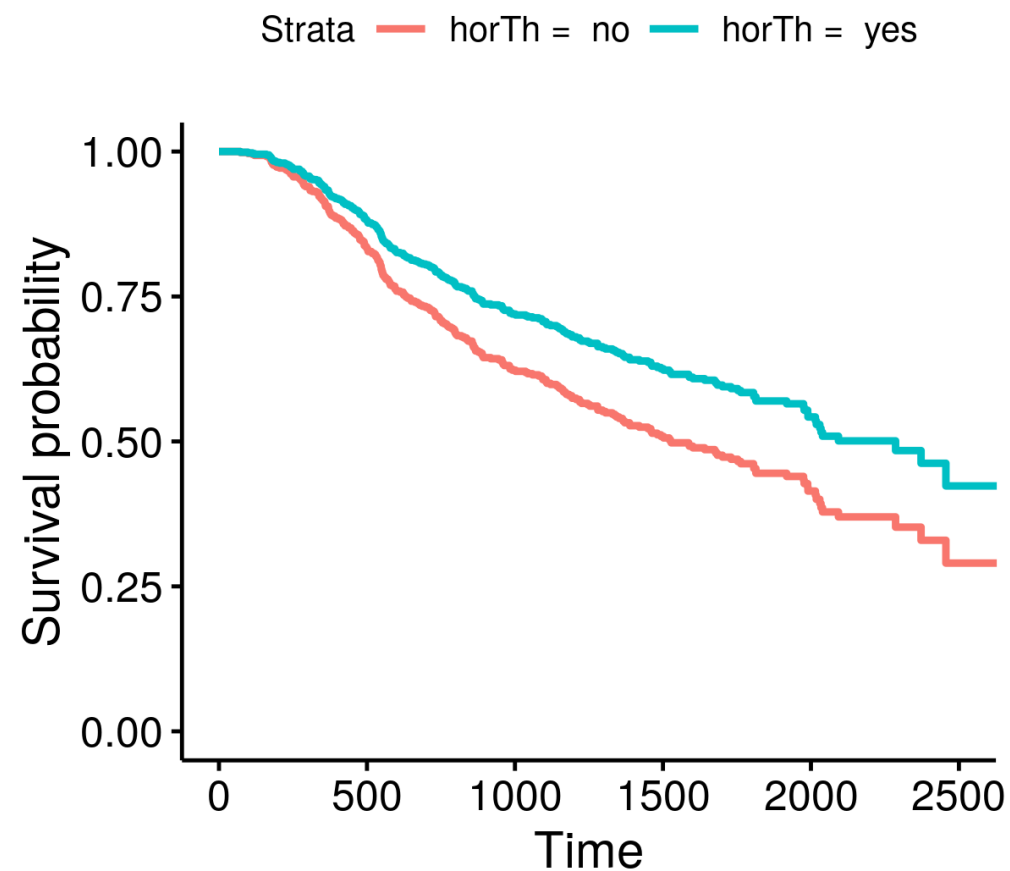
Why use a Cox model?

- semiparametric model
- less strict distributional assumptions

Weibull model



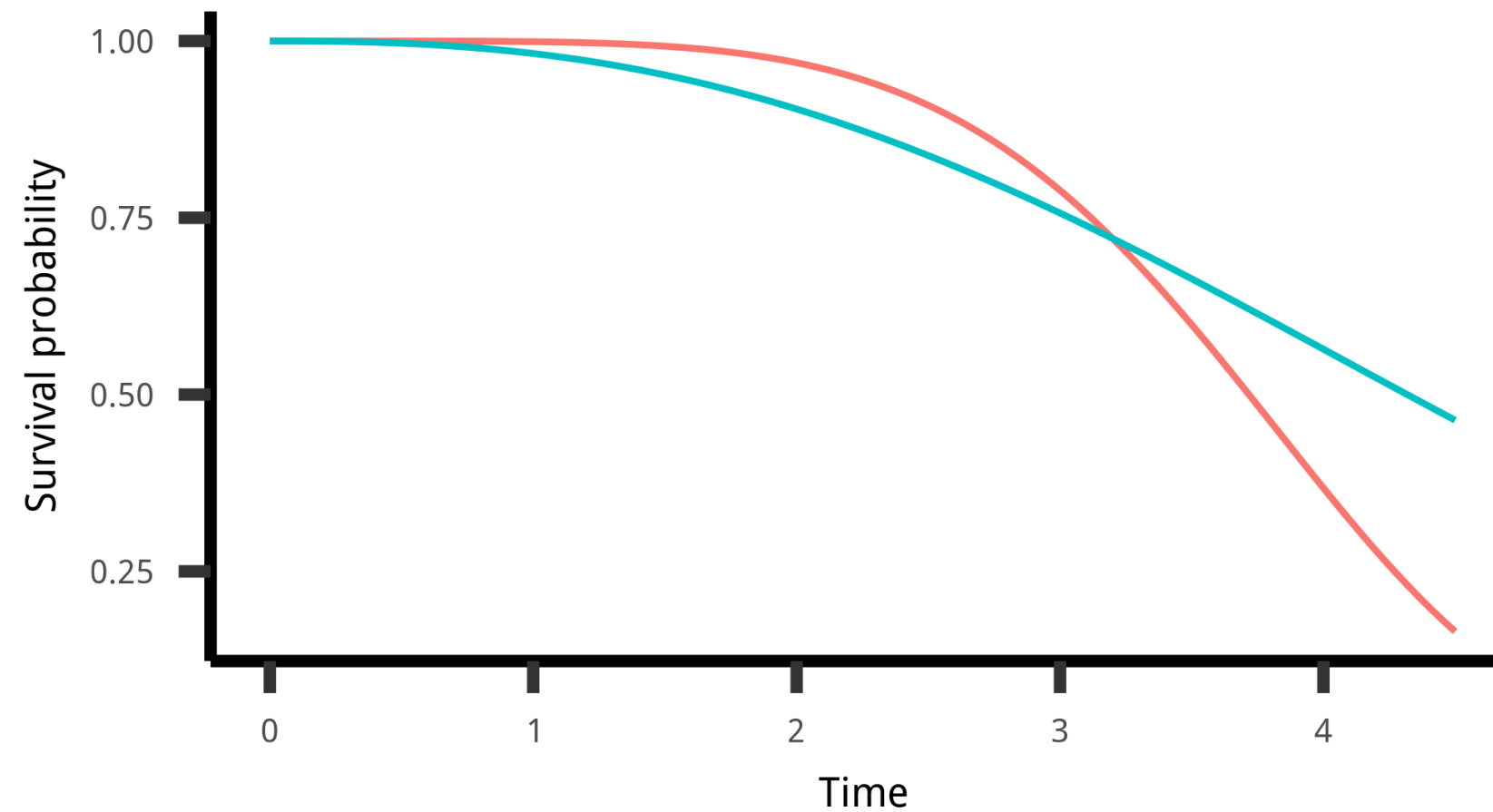
Cox model





The proportional hazards assumption

Not possible:





Computing the Cox model

Cox model:

```
cxmod <- coxph(Surv(time, cens) ~ horTh, data = GBSG2)

coef(cxmod)
#> horThyes
#> -0.3640099
```

Weibull model:

```
wbmod <- survreg(Surv(time, cens) ~ horTh, data = GBSG2)

coef(wbmod)
#> (Intercept) horThyes
#> 7.6084486 0.3059506
```



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**Let's practice computing
Cox models**



SURVIVAL ANALYSIS IN R

Visualizing the Cox model

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Steps to visualize a Cox model

- Compute Cox model
- Decide on covariate combinations ("imaginary patients")
- Compute survival curves
- Create `data.frame` with survival curve information
- Plot



Step 1

- Compute Cox model

```
cxmod <- coxph(Surv(time, cens) ~ horTh + tsize, data = GBSG2)
```

- Decide on covariate combinations ("imaginary patients")

```
newdat <- expand.grid(
  horTh = levels(GBSG2$horTh),
  tsize = quantile(GBSG2$tsize, probs = c(0.25, 0.5, 0.75))
)
rownames(newdat) <- letters[1:6]
newdat
#>   horTh tsize
#> a    no    20
#> b   yes    20
#> c    no    25
#> d   yes    25
#> e    no    35
#> f   yes    35
```




Step 2

- Compute survival curves

```
cxsf <- survfit(cxmod, data = GBSG2, newdata = newdat, conf.type = "none")  
  
str(cxsf)
```

```
#> List of 10  
#> $ n      : int 686  
#> $ time    : num [1:574] 8 15 16 17 18 29 42 46 57 63 ...  
#> $ n.risk   : num [1:574] 686 685 684 683 681 680 679 678 677 676 ...  
#> $ n.event  : num [1:574] 0 0 0 0 0 0 0 0 0 0 ...  
#> $ n.censor : num [1:574] 1 1 1 2 1 1 1 1 1 1 ...  
#> $ surv     : num [1:574, 1:6] 1 1 1 1 1 1 1 1 1 1 ...  
#> ..- attr(*, "dimnames")=List of 2  
#> .. ..$ : NULL  
#> .. ..$ : chr [1:6] "a" "b" "c" "d" ...  
#> $ type     : chr "right"  
#> $ cumhaz   : num [1:574, 1:6] 0 0 0 0 0 0 0 0 0 0 ...  
#> $ std.err  : num [1:574, 1:6] 0 0 0 0 0 0 0 0 0 0 ...  
#> $ call     : language survfit(formula = cxmod, newdata = newdat, conf.type =  
#> - attr(*, "class")= chr [1:2] "survfit.cox" "survfit"
```

Step 3

- Create `data.frame` with survival curve information

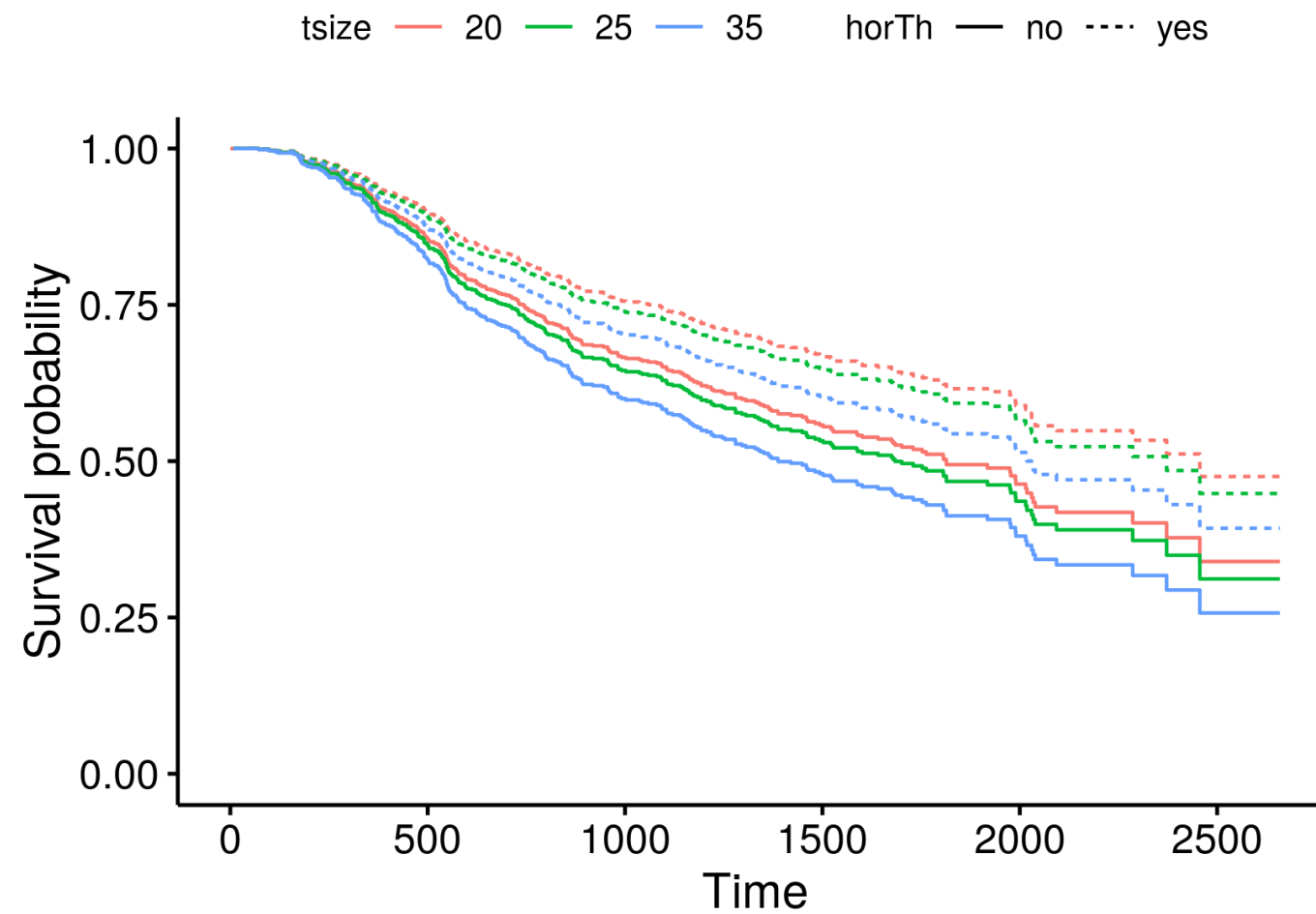
```
surv_cxmod0 <- surv_summary(cxsf)
head(surv_cxmod0)
#>   time n.risk n.event n.censor surv std.err upper lower strata
#> 1     8   686      0        1     1      0    NA    NA     a
#> 2    15   685      0        1     1      0    NA    NA     a
#> 3    16   684      0        1     1      0    NA    NA     a
#> 4    17   683      0        2     1      0    NA    NA     a
#> 5    18   681      0        1     1      0    NA    NA     a
#> 6    29   680      0        1     1      0    NA    NA     a

surv_cxmod <- cbind(surv_cxmod0,
                    newdat[as.character(surv_cxmod0$strata), ])
```

Step 4

- Plot

```
ggsurvplot_df(surv_cxmod, linetype = "horTh", color = "tsize",  
  legend.title = NULL, censor = FALSE)
```





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**Now it's your turn to
visualize!**



SURVIVAL ANALYSIS IN R

What we've learned in this course

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Concepts and Methods

CONCEPTS

- Why survival methods
- Censoring
- Survival curve

METHODS

- Kaplan-Meier Estimate
- Weibull model
- Cox model



Focus

OUR FOCUS:

- Understand what survival analysis is
- Estimate survival curves
- Visualize survival curves
- Interpret survival curves

WHAT WE DID NOT LOOK AT:

- Mathematical details
- Interpretation of effect estimates
- Inference



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**Let's practice one more
time!**



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Thanks and Good Bye

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Where you can go from here

Learn about...

- What do the model estimates mean?
- Tests, confidence intervals
- Mathematical background
- Competing risks models and other more advanced models
- Other R packages



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Have fun!