INTRODUCTION-TO-SURVIVAL-ANALYSIS-IN-R-YOUTUBE-VIDEO.R

USER

2024-02-20

```r
library(tidyverse)
```

```
## Warning: package 'ggplot2' was built under R version 4.3.2
```

```
## Warning: package 'dplyr' was built under R version 4.3.2
```

```
## Warning: package 'lubridate' was built under R version 4.3.2
```

```
## ── Attaching core tidyverse packages ──────────────────────── tidyverse
2.0.0 ──
## ✓ dplyr     1.1.3     ✓ readr     2.1.4
## ✓ forcats   1.0.0     ✓ stringr   1.5.0
## ✓ ggplot2   3.4.4     ✓ tibble    3.2.1
## ✓ lubridate 1.9.3     ✓ tidyr     1.3.0
## ✓ purrr     1.0.2
## ── Conflicts ────────────────────────────────────────
tidyverse_conflicts() ──
## ✖ dplyr::filter() masks stats::filter()
## ✖ dplyr::lag()    masks stats::lag()
## ℹ Use the conflicted package (<http://conflicted.r-lib.org/>) to force all
conflicts to become errors
```

```r
library(survival)
```

```
## Warning: package 'survival' was built under R version 4.3.2
```

```r
library(ggsurvfit)
```

```
## Warning: package 'ggsurvfit' was built under R version 4.3.2
```

```r
library(survminer)
```

```
## Warning: package 'survminer' was built under R version 4.3.2
```

```
## Loading required package: ggpubr
```

```
## Warning: package 'ggpubr' was built under R version 4.3.2
```

```
##
## Attaching package: 'survminer'
##
## The following object is masked from 'package:survival':
```

```
##
##     myeloma
```

```
library(broom)

aml <- aml

km <- survfit(Surv(time,status) ~ 1,data=aml)
km
```

```
## Call: survfit(formula = Surv(time, status) ~ 1, data = aml)
##
##       n events median 0.95LCL 0.95UCL
## [1,] 23     18     27      18      45
```

```
aml |>
  survfit(Surv(time,status)~1,data=_)
```

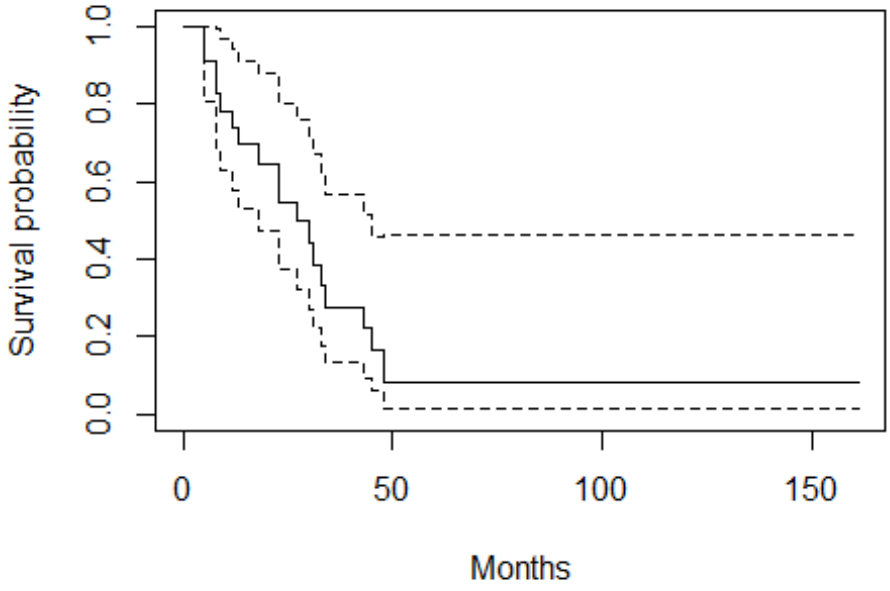
```
## Call: survfit(formula = Surv(time, status) ~ 1, data = aml)
##
##       n events median 0.95LCL 0.95UCL
## [1,] 23     18     27      18      45
```

```
## using tidy() from the broom package to create a tibble
tidy(km)
```

```
## # A tibble: 18 × 8
##     time n.risk n.event n.censor estimate std.error conf.high conf.low
##    <dbl>  <dbl>   <dbl>    <dbl>    <dbl>     <dbl>     <dbl>    <dbl>
##  1     5     23       2        0   0.913     0.0643     1       0.805
##  2     8     21       2        0   0.826     0.0957     0.996   0.685
##  3     9     19       1        0   0.783     0.110      0.971   0.631
##  4    12     18       1        0   0.739     0.124      0.942   0.580
##  5    13     17       1        1   0.696     0.138      0.912   0.531
##  6    16     15       0        1   0.696     0.138      0.912   0.531
##  7    18     14       1        0   0.646     0.157      0.878   0.475
##  8    23     13       2        0   0.547     0.196      0.803   0.372
##  9    27     11       1        0   0.497     0.218      0.762   0.324
## 10    28     10       0        1   0.497     0.218      0.762   0.324
## 11    30      9       1        0   0.442     0.248      0.718   0.272
## 12    31      8       1        0   0.386     0.282      0.671   0.223
## 13    33      7       1        0   0.331     0.321      0.622   0.177
## 14    34      6       1        0   0.276     0.369      0.569   0.134
## 15    43      5       1        0   0.221     0.432      0.515   0.0947
## 16    45      4       1        1   0.166     0.519      0.458   0.0598
## 17    48      2       1        0   0.0828    0.877      0.462   0.0148
## 18   161      1       0        1   0.0828    0.877      0.462   0.0148
```

```
km_table <- tidy(km)
```

```
plot(km,xlab="Months",ylab="Survival probability")
```

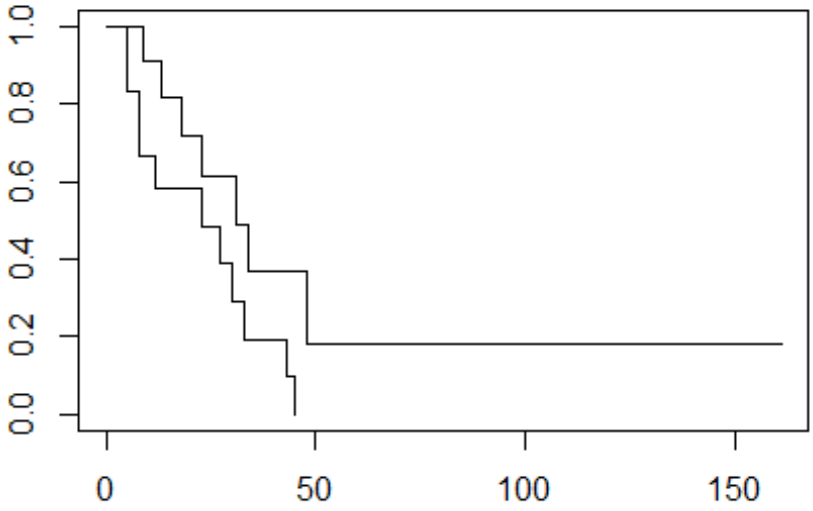


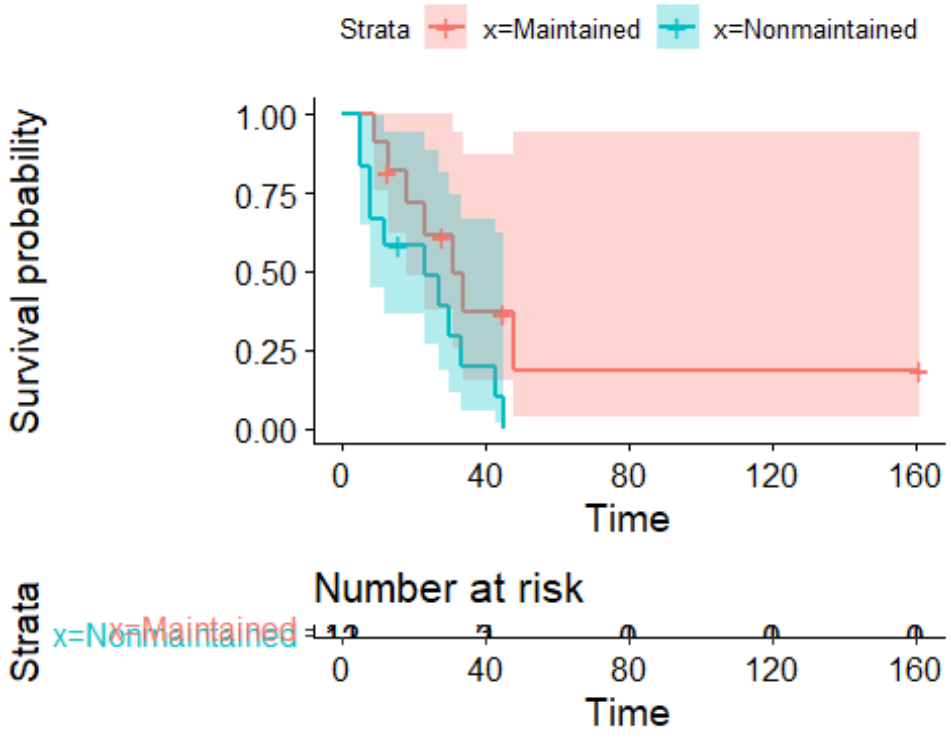

```
km2 <- aml |>
  survfit(Surv(time,status)~x,data=_)

km_table2 <- tidy(km2)
km_table2
```

```
## # A tibble: 20 × 9
##     time n.risk n.event n.censor estimate std.error conf.high conf.low
strata
##    <dbl>  <dbl>   <dbl>    <dbl>    <dbl>     <dbl>     <dbl>    <dbl>
<chr>
##  1     9     11       1        0   0.909     0.0953     1       0.754
x=Mainta…
##  2    13     10       1        1   0.818     0.142      1       0.619
x=Mainta…
##  3    18      8       1        0   0.716     0.195      1       0.488
x=Mainta…
##  4    23      7       1        0   0.614     0.249      0.999   0.377
x=Mainta…
##  5    28      6       0        1   0.614     0.249      0.999   0.377
x=Mainta…
##  6    31      5       1        0   0.491     0.334      0.946   0.255
x=Mainta…
##  7    34      4       1        0   0.368     0.442      0.875   0.155
x=Mainta…
##  8    45      3       0        1   0.368     0.442      0.875   0.155
x=Mainta…
```

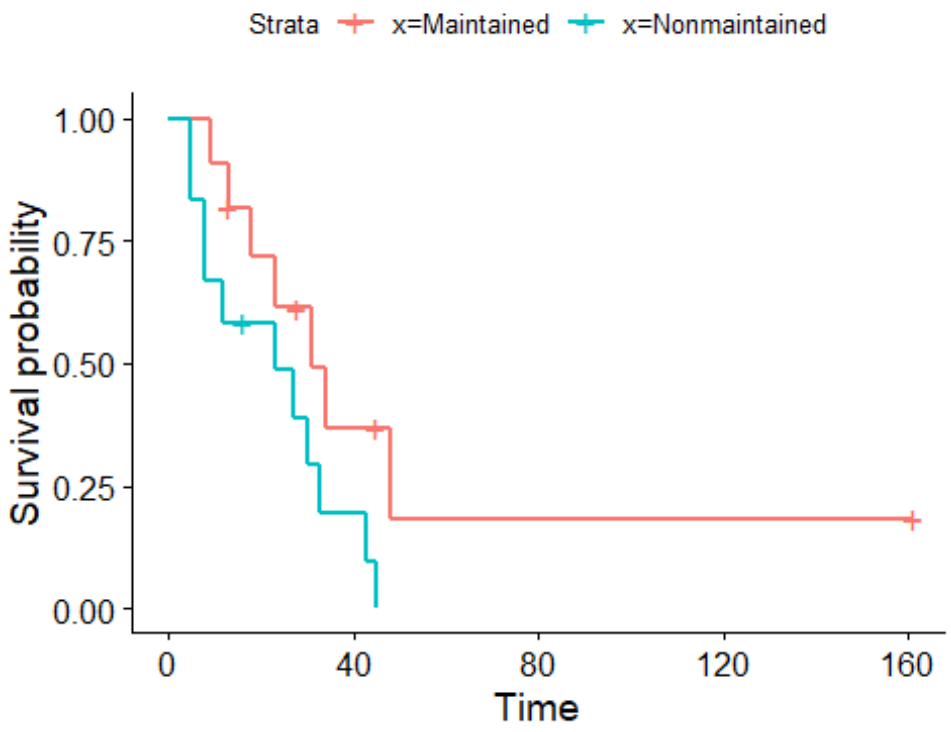
```
##  9    48      2       1        0   0.184     0.834      0.944   0.0359
x=Mainta…
## 10   161      1       0        1   0.184     0.834      0.944   0.0359
x=Mainta…
## 11     5     12       2        0   0.833     0.129      1       0.647
x=Nonmai…
## 12     8     10       2        0   0.667     0.204      0.995   0.447
x=Nonmai…
## 13    12      8       1        0   0.583     0.244      0.941   0.362
x=Nonmai…
## 14    16      7       0        1   0.583     0.244      0.941   0.362
x=Nonmai…
## 15    23      6       1        0   0.486     0.305      0.883   0.268
x=Nonmai…
## 16    27      5       1        0   0.389     0.378      0.816   0.185
x=Nonmai…
## 17    30      4       1        0   0.292     0.476      0.741   0.115
x=Nonmai…
## 18    33      3       1        0   0.194     0.627      0.664   0.0569
x=Nonmai…
## 19    43      2       1        0   0.0972    0.945      0.620   0.0153
x=Nonmai…
## 20    45      1       1        0   0       Inf         NA      NA
x=Nonmai…
```

```r
plot(km2)


## using ggsurvplot from survminer
ggsurvplot(km2,conf.int = TRUE,
           risk.table = TRUE)
```





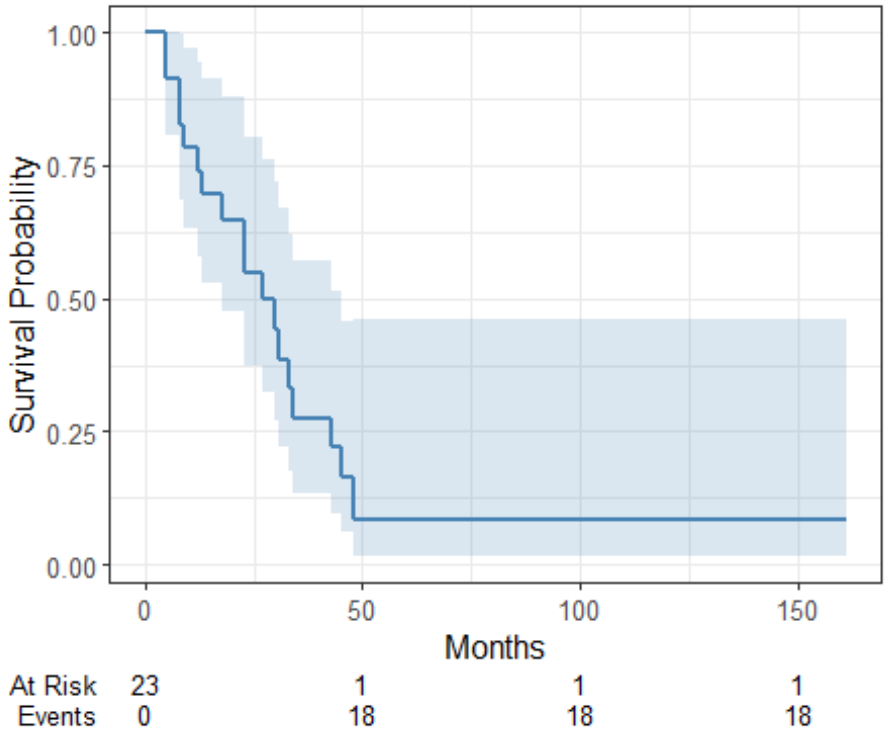

```
ggsurvplot(km2)
```



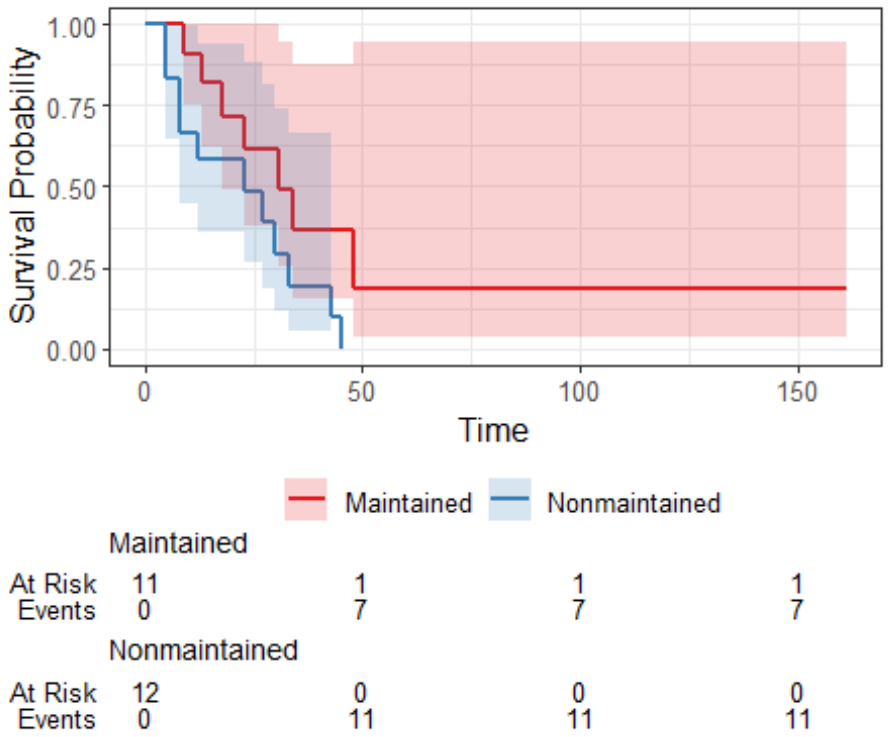

```
## to calculate the Logrank statistic to compare the two curves
## Ho : survival across the two groups are equivalent

survdiff(Surv(time,status)~x,data=aml)

## Call:
## survdiff(formula = Surv(time, status) ~ x, data = aml)
##
##                  N Observed Expected (O-E)^2/E (O-E)^2/V
## x=Maintained    11        7    10.69      1.27       3.4
## x=Nonmaintained 12       11     7.31      1.86       3.4
##
##  Chisq= 3.4  on 1 degrees of freedom, p= 0.07

##
```

```
##using ggsurvfit
km |>
  ggsurvfit(color='steelblue',linewidth=1)+
  add_risktable()+
```

```
  add_confidence_interval(fill="steelblue")+
  labs(x="Months")
```




```
aml |>
survfit2(Surv(time,status)~x,data=_) |>
  ggsurvfit(linewidth=1)+
  add_risktable()+
  scale_color_brewer(palette="Set1")+
  add_confidence_interval()+
  scale_fill_brewer(palette = "Set1")
```



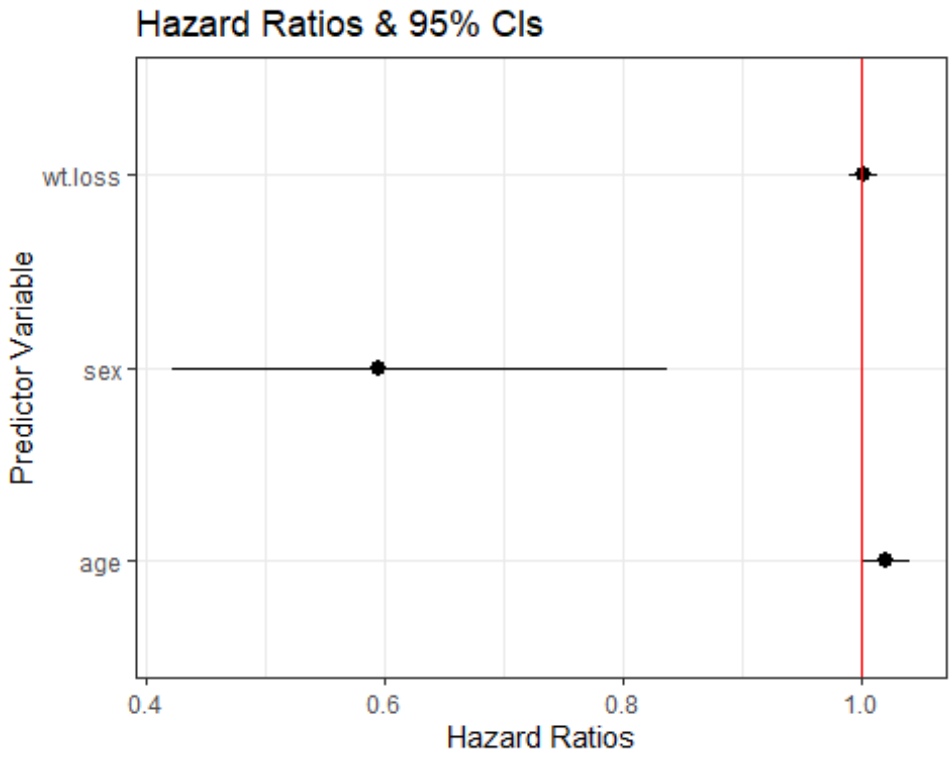

```
## if you want to fit KM for the whole dataset you use ~1
## if you want to check survival by treatment groups,use ~treatment




# COX PROPORTIONAL HAZARDS MODEL ----------------------------------------

lung <- lung
## t =survival time in days
## status 1= censored, 2 = dead
## sex 1=male, 2 = female
## wt.loss = weight loss in pounds in last 6 months
#3 age = age in years ( assessed at beginning)

## Cox model = coxph(formula,data= )
## formula = Surv(time, event) ~x1 + x2 + ..xp

lung_cox <- coxph(Surv(time,status) ~age + sex + wt.loss,data = lung)
summary(lung_cox)

## Call:
## coxph(formula = Surv(time, status) ~ age + sex + wt.loss, data = lung)
##
##   n= 214, number of events= 152
##    (14 observations deleted due to missingness)
```

```
##
##                coef  exp(coef)   se(coef)      z Pr(>|z|)
## age      0.0200882  1.0202913  0.0096644  2.079   0.0377 *
## sex     -0.5210319  0.5939074  0.1743541 -2.988   0.0028 **
## wt.loss  0.0007596  1.0007599  0.0061934  0.123   0.9024
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##          exp(coef) exp(-coef) lower .95 upper .95
## age         1.0203     0.9801    1.0011    1.0398
## sex         0.5939     1.6838    0.4220    0.8359
## wt.loss     1.0008     0.9992    0.9887    1.0130
##
## Concordance= 0.612  (se = 0.027 )
## Likelihood ratio test= 14.67  on 3 df,   p=0.002
## Wald test            = 13.98  on 3 df,   p=0.003
## Score (logrank) test = 14.24  on 3 df,   p=0.003
```

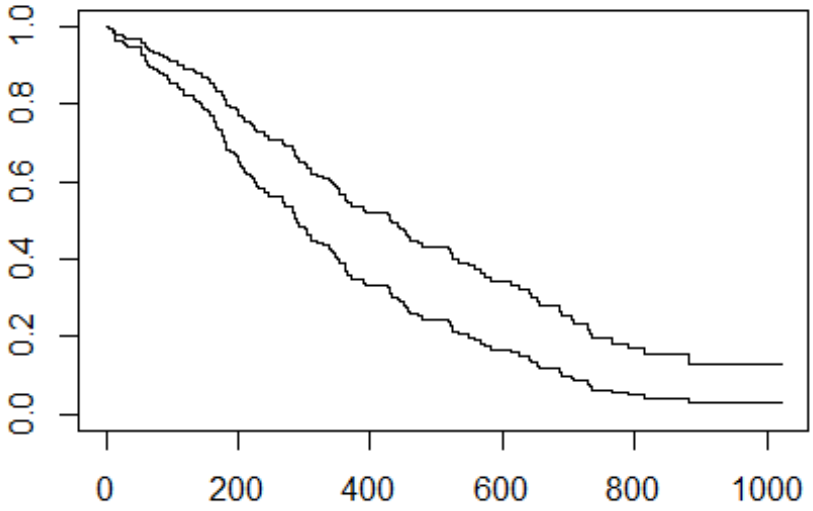
```
## tidying up cox regression output

lungcoxtab <- tidy(lung_cox,exponentiate=TRUE,conf.int = TRUE)
lungcoxtab
```

```
## # A tibble: 3 × 7
##   term    estimate std.error statistic p.value conf.low conf.high
##   <chr>      <dbl>     <dbl>     <dbl>   <dbl>    <dbl>     <dbl>
## 1 age        1.02    0.00966     2.08  0.0377     1.00      1.04
## 2 sex        0.594   0.174      -2.99  0.00280    0.422     0.836
## 3 wt.loss    1.00    0.00619     0.123 0.902      0.989     1.01
```

```
## Plotting the Hazard ratios
lungcoxtab |>
  ggplot(aes(y=term,x=estimate,xmin=conf.low,xmax=conf.high))+
  geom_pointrange()+
  geom_vline(xintercept=1,color="red")+
  labs(x="Hazard Ratios",title="Hazard Ratios & 95% CIs",y= "Predictor
Variable")+
  theme_bw()
```

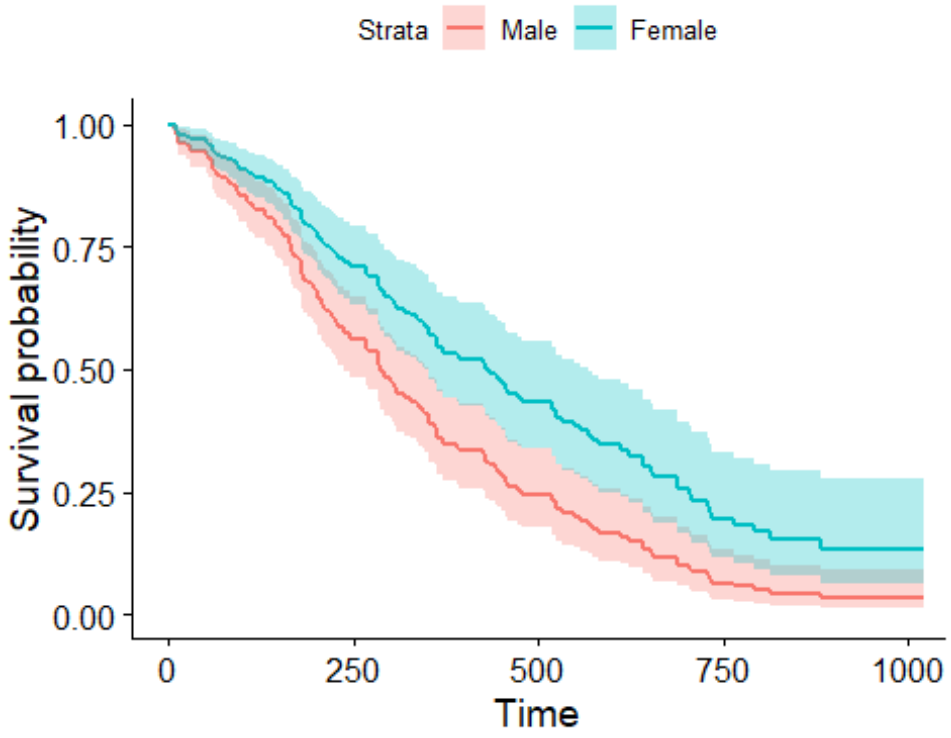



```
## Predicting survival after coxph() with survfit()

## predict survival fxn for subject with mean values on all covariates
## However predicting survival at a mean o all covariates may not make sense
## especialy if one or more of the covariates are factors(categorical)
## instead it is recommended to supply to always supply a data frame of
covariate values
## at which to predict the survival function to the newdata =() option of
survfit()

## making a new data frame
plotdata <- data.frame(age=mean(lung$age,na.rm=TRUE),
                       sex=1:2,
                       wt.loss=mean(lung$wt.loss,na.rm=TRUE))

plotdata

##        age sex  wt.loss
## 1 62.44737   1 9.831776
## 2 62.44737   2 9.831776

## supplying newdata frame to survfit
surv_by_sex <- survfit(lung_cox,newdata = plotdata)

survbysex_tab <-  tidy(surv_by_sex)

plot(surv_by_sex)
```

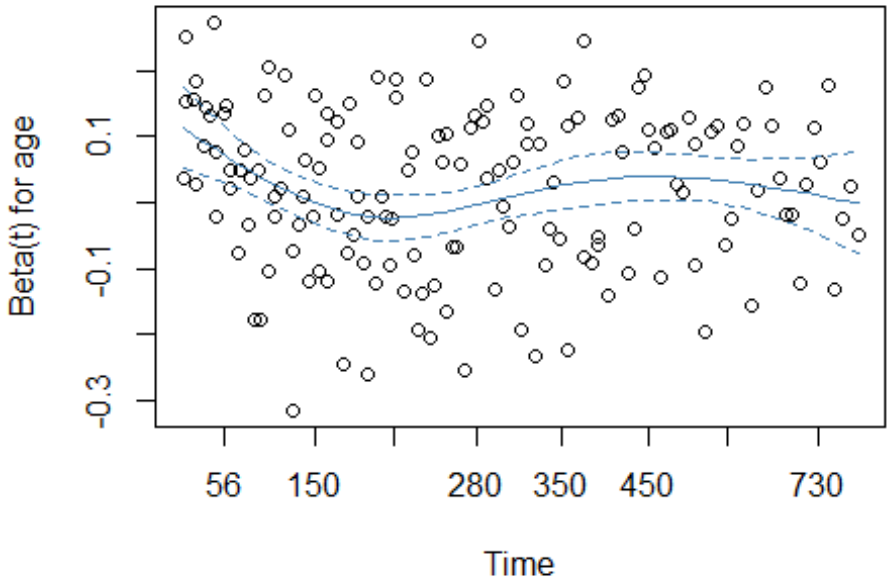


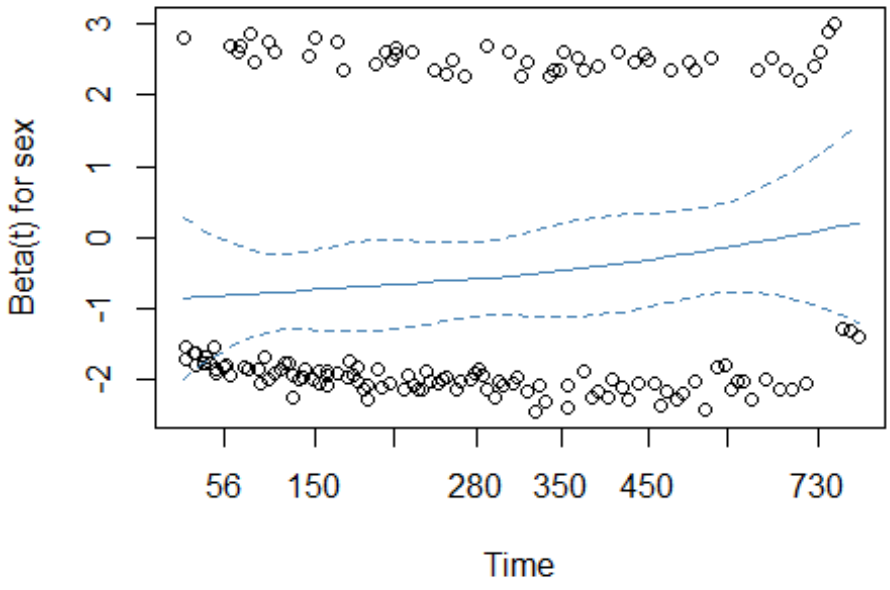

```
ggsurvplot(surv_by_sex,data=plotdata,censor=FALSE,legend.labs=c("Male","Femal
e"))
```

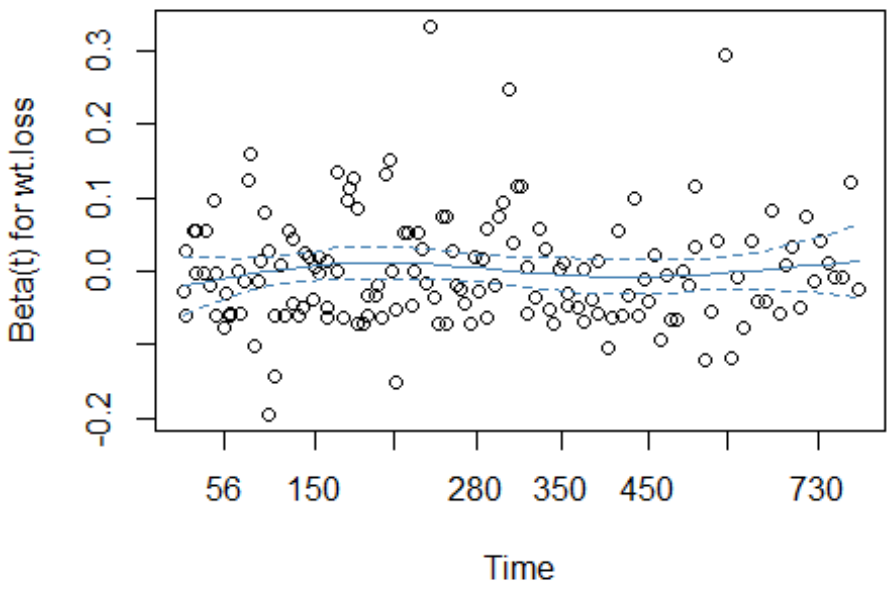
```
## Warning: `gather_()` was deprecated in tidyr 1.2.0.
## ℹ Please use `gather()` instead.
## ℹ The deprecated feature was likely used in the survminer package.
##   Please report the issue at
<https://github.com/kassambara/survminer/issues>.
## This warning is displayed once every 8 hours.
## Call `lifecycle::last_lifecycle_warnings()` to see where this warning was
## generated.
```




```
## Assesing the proportional hazards assumptions

## 1) Chi-squared test based on Scheonfeld residuals is available with
cox.zph()
##to test the hypothesis  Ho:covariate efect is constant(proportional) over
time
## Ha: covariate effect changes over time

cox.zph(lung_cox)

##          chisq df    p
## age     0.5077  1 0.48
## sex     2.5489  1 0.11
## wt.loss 0.0144  1 0.90
## GLOBAL  3.0051  3 0.39

plot(cox.zph(lung_cox),col="steelblue")
```


Beta(t) for age
0.1
-0.1
-0.3
56
150
280
350
450
730
Time


Beta(t) for sex
3
2
1
0
-1
-2
56
150
280
350
450
730
Time


Beta(t) for wt.loss
0.3
0.2
0.1
0.0
-0.2
56
150
280
350
450
730
Time