

Appendix

STA442 Homework 3

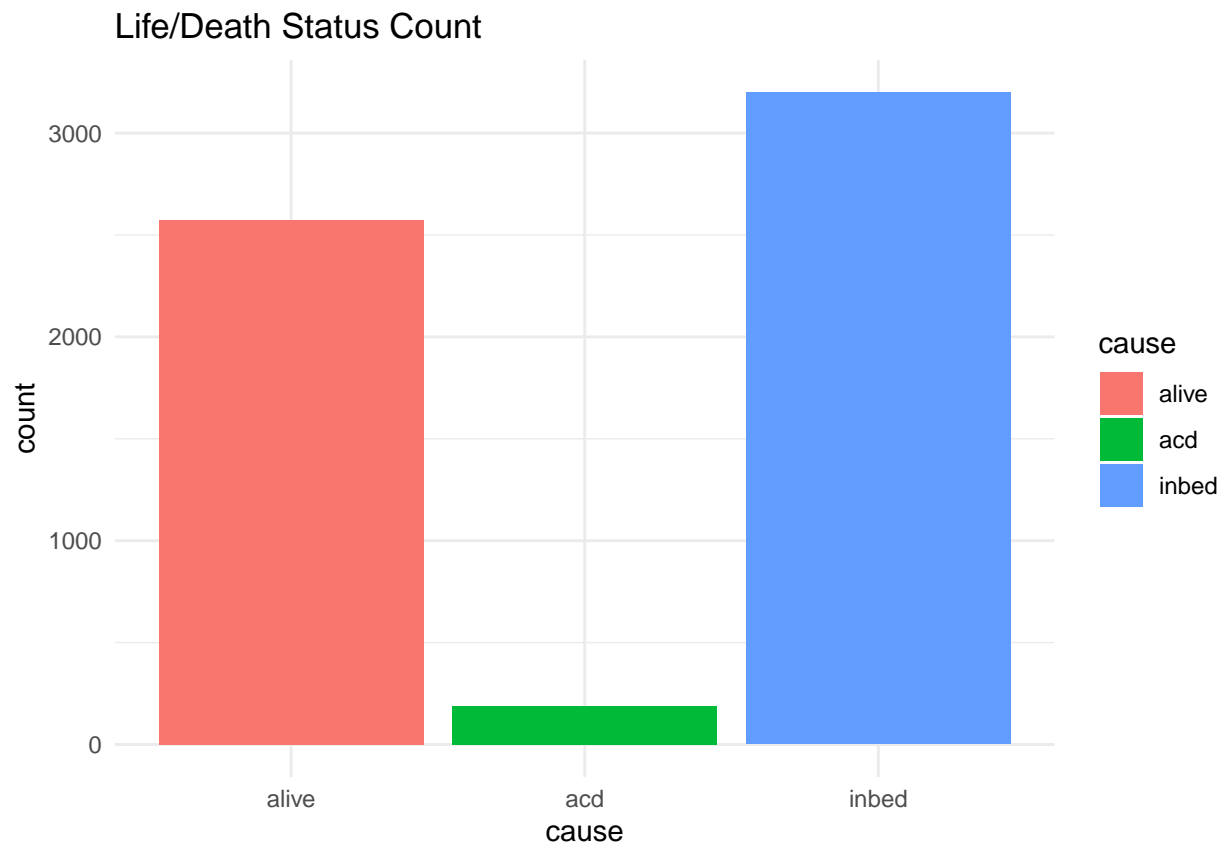
Jiaqi Bi

```
# Load Data, filter data
data("cricketer", package="DAAG")
dat=cricketer[cricketer$year<1890 & cricketer$acd==1,]
library(ggplot2)
library(tidyverse)

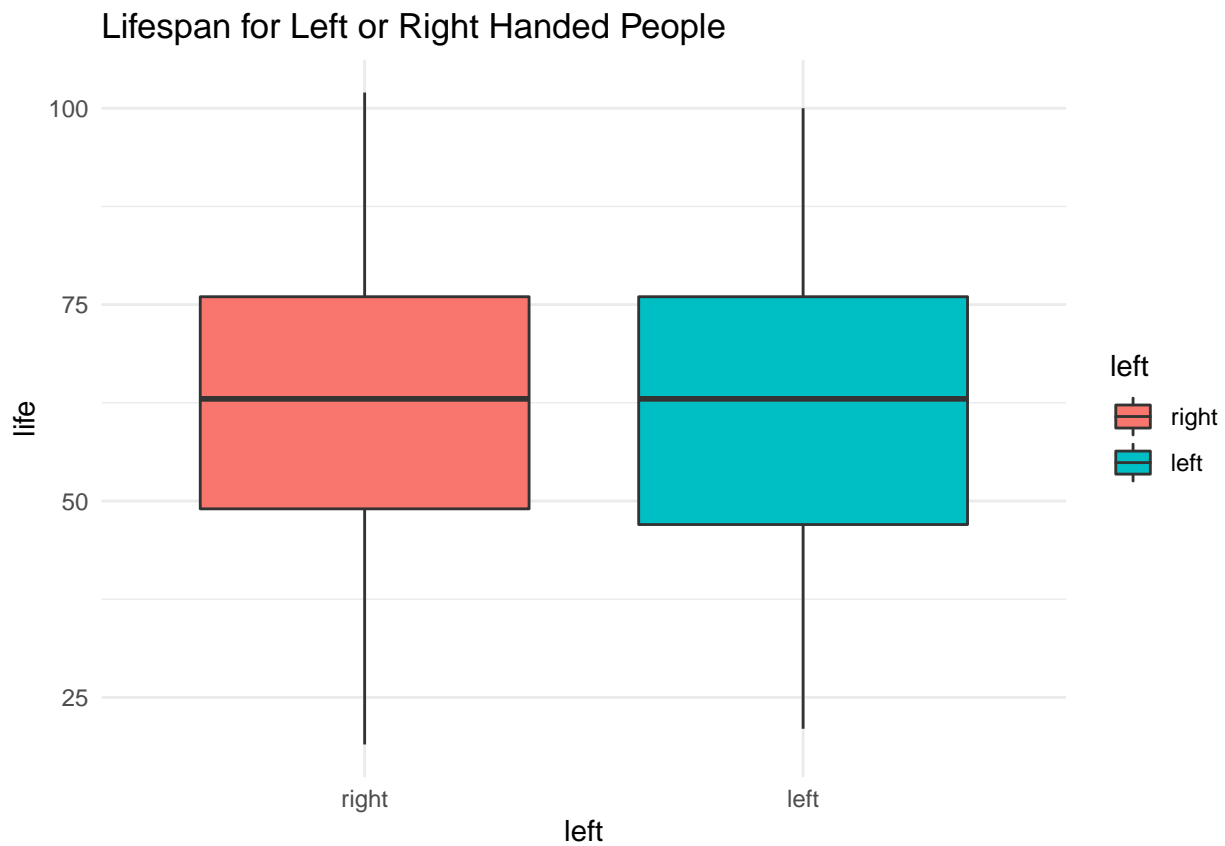
## -- Attaching packages ----- tidyverse 1.3.1 --
## v tibble  3.1.5      v dplyr   1.0.7
## v tidyr   1.1.4      v stringr 1.4.0
## v readr   2.0.2      v forcats 0.5.1
## v purrr   0.3.4

## -- Conflicts ----- tidyverse_conflicts() --
## x dplyr::filter() masks stats::filter()
## x dplyr::lag()    masks stats::lag()

library(survival)
cricketer %>% ggplot(aes(x=cause, fill=cause)) +
  geom_bar() +
  ggtitle("Life/Death Status Count") +
  theme_minimal()
```



```
cricketer %>% ggplot(aes(x=left,y=life,fill=left)) +  
  geom_boxplot() +  
  ggtitle("Lifespan for Left or Right Handed People") +  
  theme_minimal()
```



```
library('INLA')
```

```
## Loading required package: Matrix
##
## Attaching package: 'Matrix'
## The following objects are masked from 'package:tidyr':
##   expand, pack, unpack
## Loading required package: foreach
##
## Attaching package: 'foreach'
## The following objects are masked from 'package:purrr':
##   accumulate, when
## Loading required package: parallel
## Loading required package: sp
## This is INLA_21.02.23 built 2021-11-20 00:17:21 UTC.
## - See www.r-inla.org/contact-us for how to get help.
## - To enable PARDISO sparse library; see inla.pardiso()
## - Save 273.9Mb of storage running 'inla.prune()'
```

```

dat$decade <- (dat$year - 1850)/10
dat$lifeC <- dat$life/100
dat$ones <- 1
cFitI <- inla(lifeC ~ decade + left, data=dat, family='weibull', control.family=list(variant=1,

## Warning in .recacheSubclasses(def@className, def, env): undefined subclass
## "numericVector" of class "Mnumeric"; definition not updated

knitr::kable(rbind(cFitI$summary.fixed[,c(1,2,3,5)], cFitI$summary.hyper[,c(1,2,3,5)]), digits=

```

	mean	sd	0.025quant	0.975quant
(Intercept)	0.613	0.180	0.239	0.947
decade	0.131	0.060	0.018	0.254
leftleft	0.076	0.135	-0.198	0.336
alpha parameter for weibull	1.727	0.110	1.521	1.953

Positive leftleft means the time scale for dying 7.6% smaller for lefties, which means the

```
exp(qnorm(c(0.025, 0.5, 0.975), mean=log(7.5), sd=2/3))
```

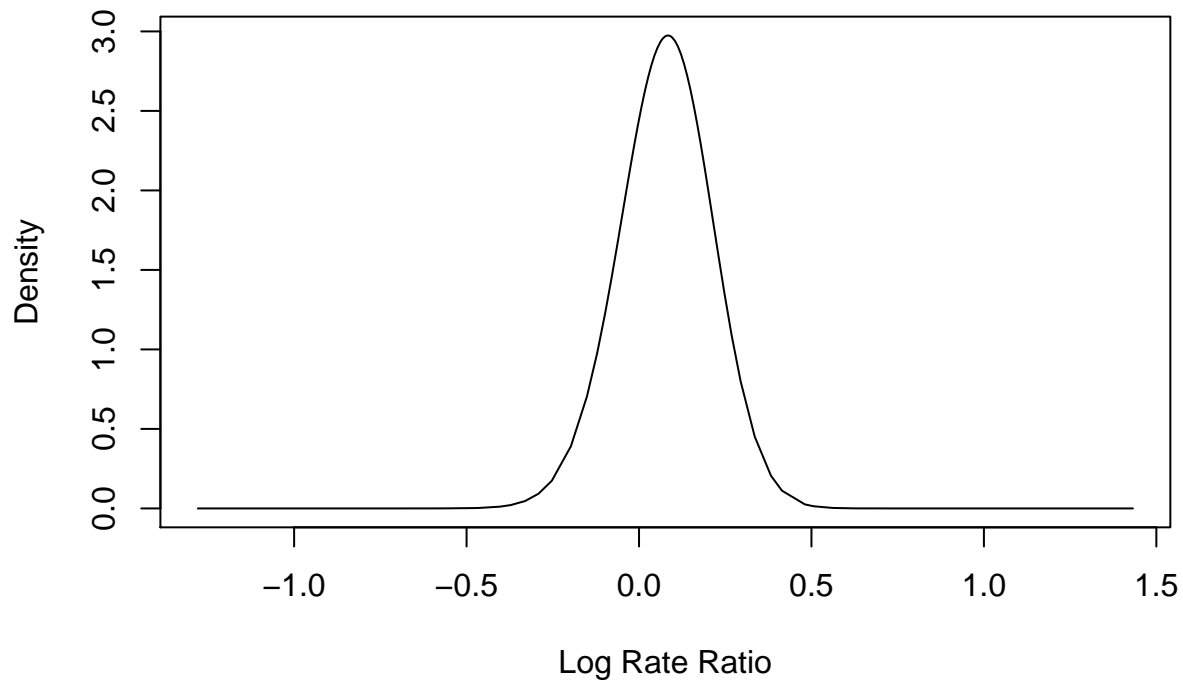
```
## [1] 2.030456 7.500000 27.703138
```

We choose the prior for alpha to be 7.5 because life times are left-skewed with mean around

Left Hand Effect

```
plot(cFitI$marginals.fixed$leftleft, type="l", xlab="Log Rate Ratio", ylab="Density", main="Left
```

Left Handed Effects



Mostly > 0

Considering who are not dead yet with their lifetimes censored

```
cricketer$decade <- (cricketer$year - 1850)/10
cricketer$deadAccident <- as.numeric((cricketer$acd==1) & (cricketer$dead==1))
cricketer$lifeC <- cricketer$life/100
cricketer$timeC <- (cricketer$year - 1900)/100
cFitC <- inla(inla.surv(lifeC, deadAccident)~ timeC + left, data=cricketer, family='weibullsurv')
knitr::kable(rbind(cFitC$summary.fixed[, c(1,3,5)], cFitC$summary.hyper[, c(1,3,5)]), digits=3)
```

	mean	0.025quant	0.975quant
(Intercept)	-2.198	-2.496	-1.935
timeC	-0.563	-0.930	-0.208
leftleft	0.322	0.073	0.567
alpha parameter for weibullsurv	1.348	1.221	1.483

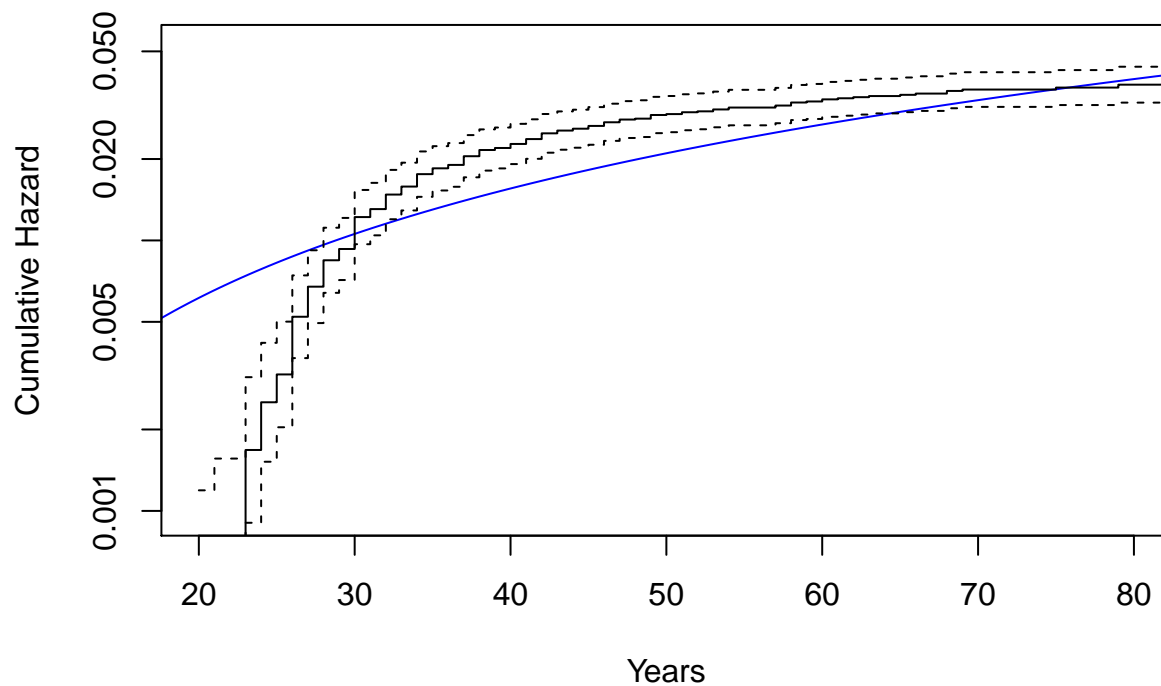
Interpretation: Left-handed people live 32.2% shorter lives than right handed people with

INLA's posterior mode vs. data

```
xSeq = seq(5, 100, len=1000)
kappa=cFitC$summary.hyper['alpha', 'mode']
lambda=exp(-cFitC$summary.fixed['(Intercept)', 'mode'])
plot(xSeq, (xSeq/(100*lambda))^kappa, col="blue", type="l", log="y", xlab="Years", ylab="Cumula")
```

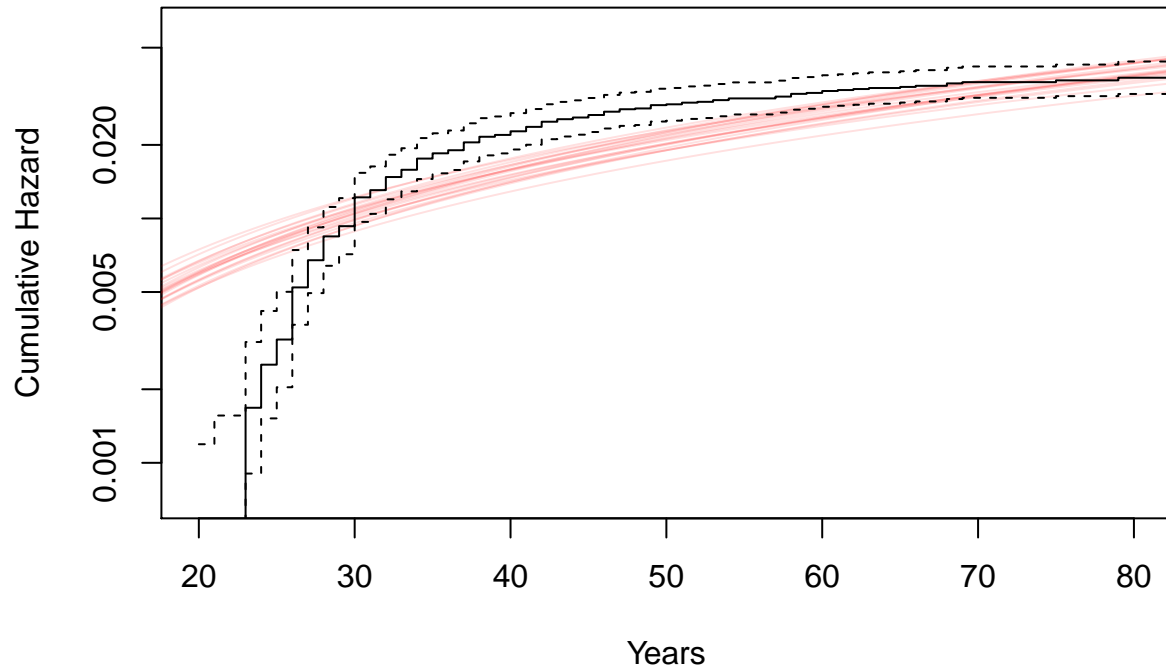
```
hazEst=survfit(Surv(life, deadAccident)~1, data=cricketer)
lines(hazEst, fun='cumhaz')
```

Summary of Estimated Posterior Hazard



```
xSeq=seq(5, 100, len=1000)
densHaz=Pmisc::sampleDensHaz(fit=cFitC, x=xSeq, n=20, scale=100)
matplot(xSeq, densHaz[, "cumhaz", ], type="l", lty=1, col="#FF000020", log="y", xlim=c(20,80),
lines(hazEst, fun="cumhaz"))
```

Hazard of Posterior Samples



results

```
knitr::kable(rbind(cFitC$summary.fixed[, c(1,3,5)], cFitC$summary.hyper[, c(1,3,5)]), digits=3)
```

	mean	0.025quant	0.975quant
(Intercept)	-2.198	-2.496	-1.935
timeC	-0.563	-0.930	-0.208
leftleft	0.322	0.073	0.567
alpha parameter for weibullsurv	1.348	1.221	1.483

Left handed people live 32.2% shorter (95% CI 7.3% to 56.6%) for the accidental death than

May not be useful

```
#resTable=rbind(exp(cFitC$summary.fixed[, c(4,5,3)]), cFitC$summary.hyperpar[, c(4,5,3)])
```

```
#rownames(resTable)=c('Reference (Born 1900, Right)', 'Birth Year (Per Century)', 'Left Handed')
```

```
#colnames(resTable)=c('Est.', 'Upper', 'Lower')
```

```
#knitr::kable(resTable[c(4,1,2,3),], digits=3)
```

#Relative Lifetime for lefties and righties

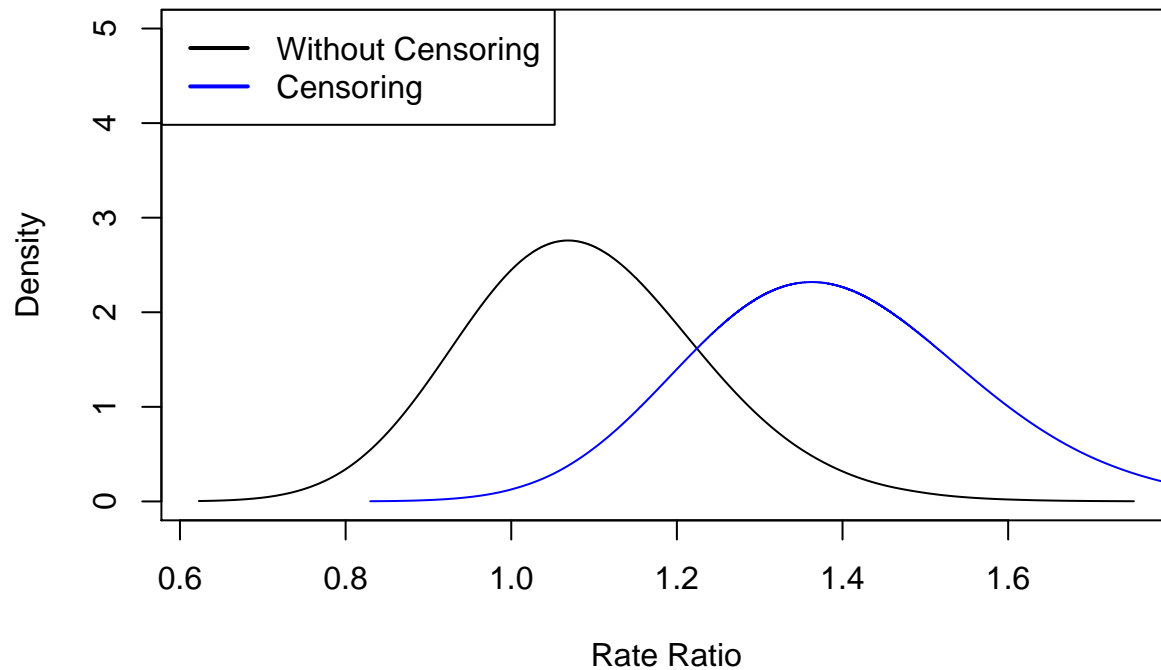
```
plot(inla.tmarginal(exp, cFitI$marginals.fixed$leftleft, n=10000),
```

```
type="l", xlab="Rate Ratio", ylab="Density", ylim=c(0,5), main="Relative Lifetime for Left
```

```
lines(inla.tmarginal(exp, cFitC$marginals.fixed$leftleft, n=20000), col='blue')
```

```
legend("topleft", col=c("black", "blue"), lty=1, lwd=2, legend=c("Without Censoring", "Censoring"))
```

Relative Lifetime for Left and Right Handed



Before 1890, lefties have higher death rate than righties, the death rate for lefties increases

```
xSeq = seq(20, 110, len=100)
Sshape = c(2, 5, 10, 20)
names(Sshape) = RColorBrewer::brewer.pal(length(Sshape), 'Dark2')
yMat = NULL
for(Dshape in Sshape)
  yMat = cbind(yMat, dweibull(xSeq, shape=Dshape,
    scale=70/gamma(1+1/Dshape))
  )
matplot(xSeq, yMat, type='l', lty=1, col=names(Sshape), lwd=2,
  ylim = c(0, 0.1), xlab='x', ylab='Density', main="Prior Alpha Weibull Plot")
legend('topright', lty=1, col=names(Sshape), legend=Sshape, lwd=4,
  title = 'alpha')
```


Prior Alpha Weibull Plot

