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STA442
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Relationship between the lifespan of Accidental Deaths and the Use of Dominant Hands

Introduction

Our genes determine whether we are left-handed or right-handed. Because of this phenomenon, people are always probing the relationship between dominant hands and various phenomenons such as accidental deaths . Therefore, I proposed a hypothesis that left-handed people are more likely to experience an accidental death than right-handed people. Hence, I collected the data of Lifespans of UK 1st class cricketers born 1840-1960 recorded in 1992. Based on this data, we analyzed the relationship between dominant hands and lifespan of accidental deaths.

Method

Since our response variable is lifespan, people in 1992 would either be alive or dead. Hence the lifespan in our data would not reflect the true lifespan of cricketers. In this case, I censored all scenarios except the subjects that died in accidents. Thus, I decided to use INLA to fit a Weibull model with variant =1. The model is established as follows.

$$Z_i|Y_i, A_i = min(Y_i, A_i)$$
$$E_i|Y_i, A_i = I(Y_i < A_i)$$
$$Y_i \sim Weibull(\lambda_i, \alpha)$$
$$\lambda_1 = exp(-\eta_i)$$
$$\eta_i = \beta_0 + X_i\beta$$

where Z_i is the actual lifetime in 1992 corresponding to individual i.

Y_i is the averaged censored lifetime if the individual i is not dead because of accidents. Where λ_i is the scale parameter and α demonstrates the shape.

E_i is an indicator function. When $E_i = 0$, then $Z_i < Y_i < \infty$. This represents when $E_i = 0$, the individual i is either alive or died because of killed or inbed.

When $E_i = 1$, then $Z_i = Y_i$. This shows when $E_i = 1$, the individual i is died in accidents.

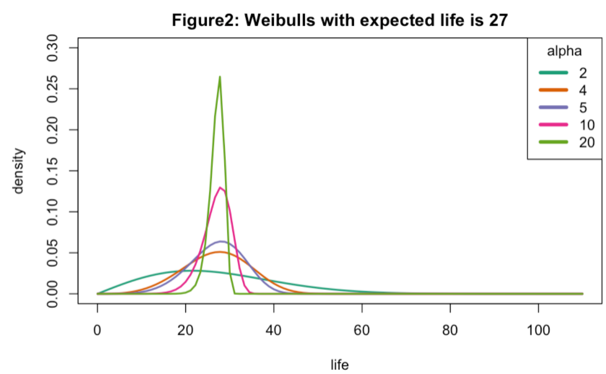
A_i is individual *i*'s age in 1992 (when data were collected).Calculated by 1992-birth of individual i.

X_i has indicator variables for decades of being born after 1850 and dominant hands. Since dominant hands is a dummy variable, we choose the left hand as our base.

β_0 represents the intercept when X_i is 0.

βrepresents the corresponding parameters of X_i.

And from Figure1, we could see that people's age in 25-30 have the highest frequency of accidental death. Thus we could plot Figure 2, which is Weibulls with expected life is 27. From this plot, we could observe the difference of the shape parameters in Weibulls. When alpha is 10, 20 and 5, the distribution is too sharp while when alpha is 2, the distribution is too flat. Hence I chose the distribution with alpha is 4. Therefore, it is reasonable to assign prior to log(4) in the model.



Results

Table 1 shows the result of natural scales. It demonstrates the posterior median and 95% interval for Weibull model parameters. Shown are the shape parameter and the scale parameter for the left-handed, along with relative expected lifetime and a decade change from 1850.

From table 1, we could observe that the estimation of birth year(per decade) is 1.03. This represents if the year an individual is being born is increasing by 1 leads to increasing lifetime by 3%. Also since 1,which is e^0, is located between lower(0.971) and upper(1.095)(95% confidence interval). Thus, it has no evidence to support our null hypothesis, which indicates that there might be no relationship between lifetime of accidental death and birth year in decades after 1850.

From table2, the est of left-handed is -3.225 shows left-handed people have 3.23% shorter lives than right-handed. Besides, also since 1 is located in 95% confidence interval, which is between 0.620 and 1.597 (lower and upper). Hence, it has no evidence to support our null hypothesis, which indicates that there might be no relationship between lifetime of accidental death and dominated hand.

	est	lower	upper
shape	1.294	1.456	1.149
birth year (per decade)	1.030	0.971	1.095
left handed	0.968	0.620	1.597

Table 1

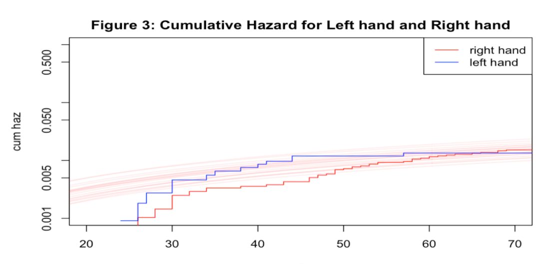


Figure 3

	est	lower	upper
	<dbl>	<dbl>	<dbl>
left handed	-3.225017	-37.96923	59.67557

Table 2

Furthermore, the blue lines and red lines in Figure 3 are plotted by the model fitted by survival analysis demonstrating the estimated lifetime of cricketers. Most of the blue line located above the red line shows that the cumulative hazard(death rate) of left-handed people might be greater than right-handed people.

In conclusion, although from the plots we could conclude there might be a relationship of dominated hands and lifetime of accidental death, that left-handed people are more susceptible to accidental death than right-handed people, by Weibull model, it still does not have a strong evidence to show the relationship.

Appendix

````
```{r}
library(tidyverse)
library(survival)
library(INLA)
```
````

Question1

````
```{r}
#data manipulation
data("cricketer", package = "DAAG")
dat = cricketer %>%
  mutate(status=ifelse(cricketer$acd ==1 &cricketer$kia == 0 & cricketer$inbed == 0,1,0))
dat$decade=(dat$year-1850)/10
dat$lifeC=dat$life/100


```
````

````
```{r,verbose=TRUE}
cFitC = inla(inla.surv(lifeC, status) ~ decade + left,
data=dat, family='weibullsurv',
control.family = list(variant=1, hyper=list(alpha = list(
prior = 'normal', param = c(log(4), (2/3)^(-2)) ))
), control.compute = list(config=TRUE),
control.inla = list(strategy='laplace', fast=FALSE, h=0.0001),
control.mode = list(theta = log(6), restart=TRUE))
```
````

````
```{r}
resTable = rbind(exp(-cFitC$summary.fixed[,c(4,5,3)]), cFitC$summary.hyper[,c(4,3,5)])
rownames(resTable) = c('reference', 'birth year (per decade)', 'left handed','shape')
colnames(resTable) = c('est','lower','upper')
knitr::kable(resTable[c(4,2,3),],digits=3)
100 * (resTable["left handed", ] - 1)
```
````

````
```{r}
new_data=filter(dat,status==1)
hist(new_data$life,
     main = "Figure1: Histogram of Life dead by Accidents",
     xlab = "Life")
```
````

````
```{r}
xSeq = seq(0, 110, len=100)
Sshape = c(2 ,4, 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=27/gamma(1+1/Dshape))
  )
matplot(xSeq, yMat, type='l', lty=1, col=names(Sshape), lwd=2,
  ylim = c(0, 0.3), xlab='life',ylab='density')
title(main="Figure2: Weibulls with expected life is 27")
legend('topright', lty=1, col=names(Sshape), legend=Sshape, lwd=4,
  title = 'alpha')
```
````

```
```{r, echo=FALSE, warning=FALSE, message=FALSE}
hazEst = survfit(Surv(life, status) ~ left, data = dat)
xSeq = seq(0, 100, len = 200)
densHaz = Pmisc::sampleDensHaz(fit = cFitC, x = xSeq, n = 20, scale = 100)
matplot(xSeq, densHaz[, "cumhaz", ], type = "l", lty = 1,
        col = "#FF000020", log = "y", ylim = c(0.001,1), xlim = c(20, 70),
        xlab = "life",ylab = "cum haz",
        main = "Figure 3: Cumulative Hazard for Left hand and Right hand")
lines(hazEst, fun = "cumhaz",col=c("red","blue"))
legend("topright",col=c("red","blue"),legend=c("right hand", "left hand"),lty=1)
```
```