

```
library(splines)
```

```
library(survival)
```

```
#read data
```

```
data=read.csv("cancer.csv", sep=";", dec=",")
```

```
head(data)
```

```
names(data)
```

```
dim(data)
```

```
#Create a survival object
```

```
Surv(data$time,data$status)
```

```
#Create survival curves
```

```
KM_1 <- survfit(Surv(data$time,data$status)~1)
```

```
KM_1
```

```
summary(KM_1)
```

```
#Plot survival curve with confidence intervals
```

```
plot(KM_1, mark.time=F)
```

```
#Kaplan-Meier survival curves according ln_yesno
```

```
KM.ln <- survfit(Surv(data$time,data$status)~ 1+data$ln_yesno)
```

```
KM.ln
```

```
summary(KM.ln)
```

```
#Plot survival curve according ln_yesno
```

```
plot(KM.ln,col=c("red","blue"),mark.time=F,ylim=c(0,1),xlab="time",ylab="S")
```

```
legend("topright", title="Lymph nodes", legend=c("No", "Yes"), col=c("red", "blue"),  
      lty=1:1, cex=0.8)
```

```
#Log-rank test
```

```
survdif(Surv(data$time,data$status)~ 1+data$ln_ynsno,rho=0)
```

```
#Unadjusted Cox regression for the covariate ln_ynsno
```

```
cox1 <- coxph(Surv(data$time,data$status)~ 1+data$ln_ynsno)
```

```
summary(cox1)
```

```
#Unadjusted Cox regression for the covariate age
```

```
cox2 <- coxph(Surv(data$time,data$status)~ 1+data$age)
```

```
summary(cox2)
```

```
#Unadjusted Cox regression for the covariate pathsize
```

```
cox3 <- coxph(Surv(data$time,data$status)~ 1+data$pathsize)
```

```
summary(cox3)
```

```
#Adjusted Cox regression for the covariates ln_ynsno, age, pathsize
```

```
cox4 <- coxph(Surv(data$time,data$status)~ 1+data$age+data$ln_ynsno+data$pathsize)
```

```
summary(cox4)
```

```
#Verification of assumptions
```

```
test.res <- cox.zph(cox4)
```

```
test.res
```

```
library(survminer)
```

```
ggcoxzph(test.res)
```