Análise de Sobrevivência

Modelos Paramétricos

Ricardo Accioly

Modelos Paramétricos

Modelos Paramétricos

Nesta apresentação vamos ver passo a passo como obter a função taxa de falhas e de sobrevivência para alguns modelos de probabilidade.

Modelos Paramétricos

Nesta apresentação vamos ver passo a passo como obter a função taxa de falhas e de sobrevivência para alguns modelos de probabilidade.

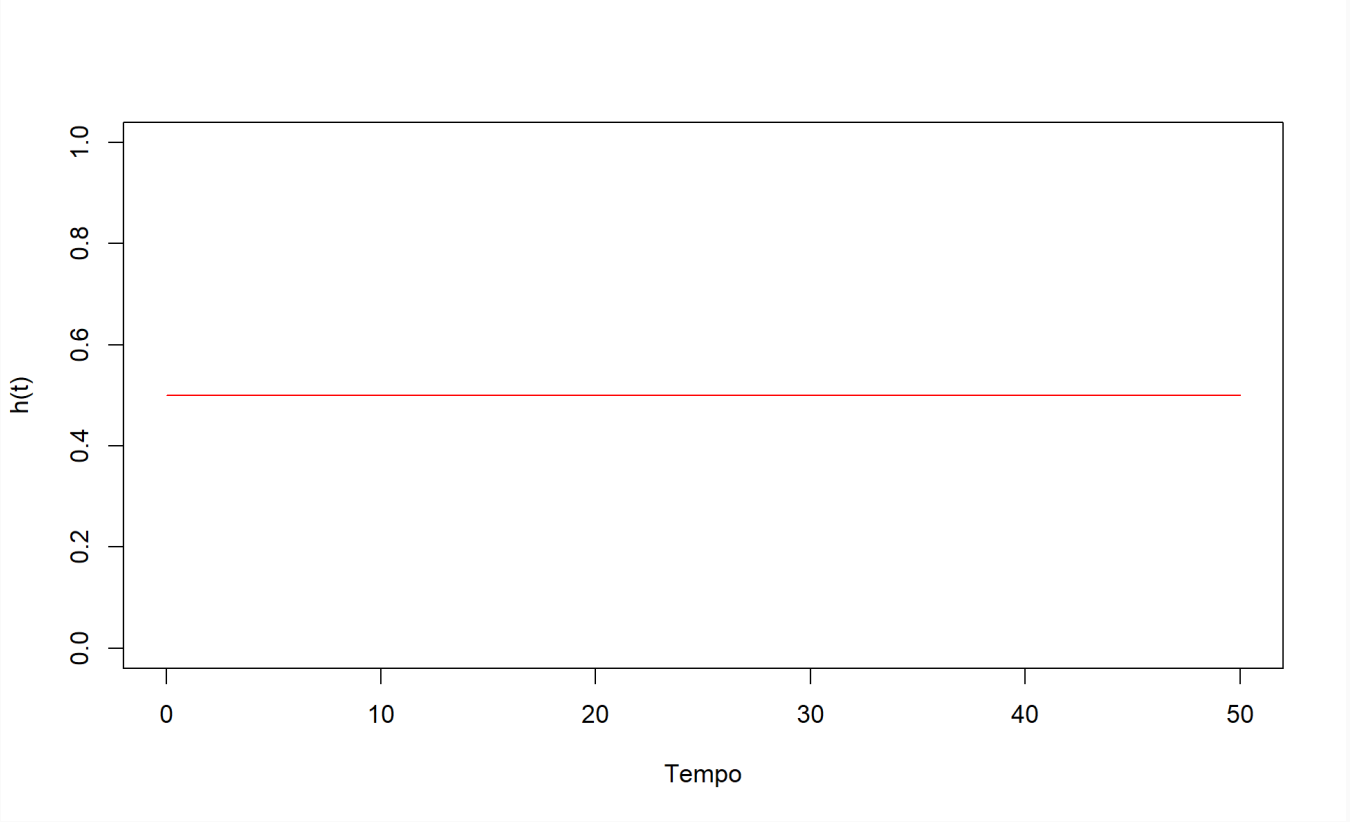
Aqui vamos utilizar as funções existentes no pacote `stats` que vem com a instalação padrão do R.

Modelos Paramétricos - Exponencial

```
expHaz ← function(x, rate) {
  dexp(x, rate=rate)/
    pexp(x, rate=rate, lower.tail=F)
}
```

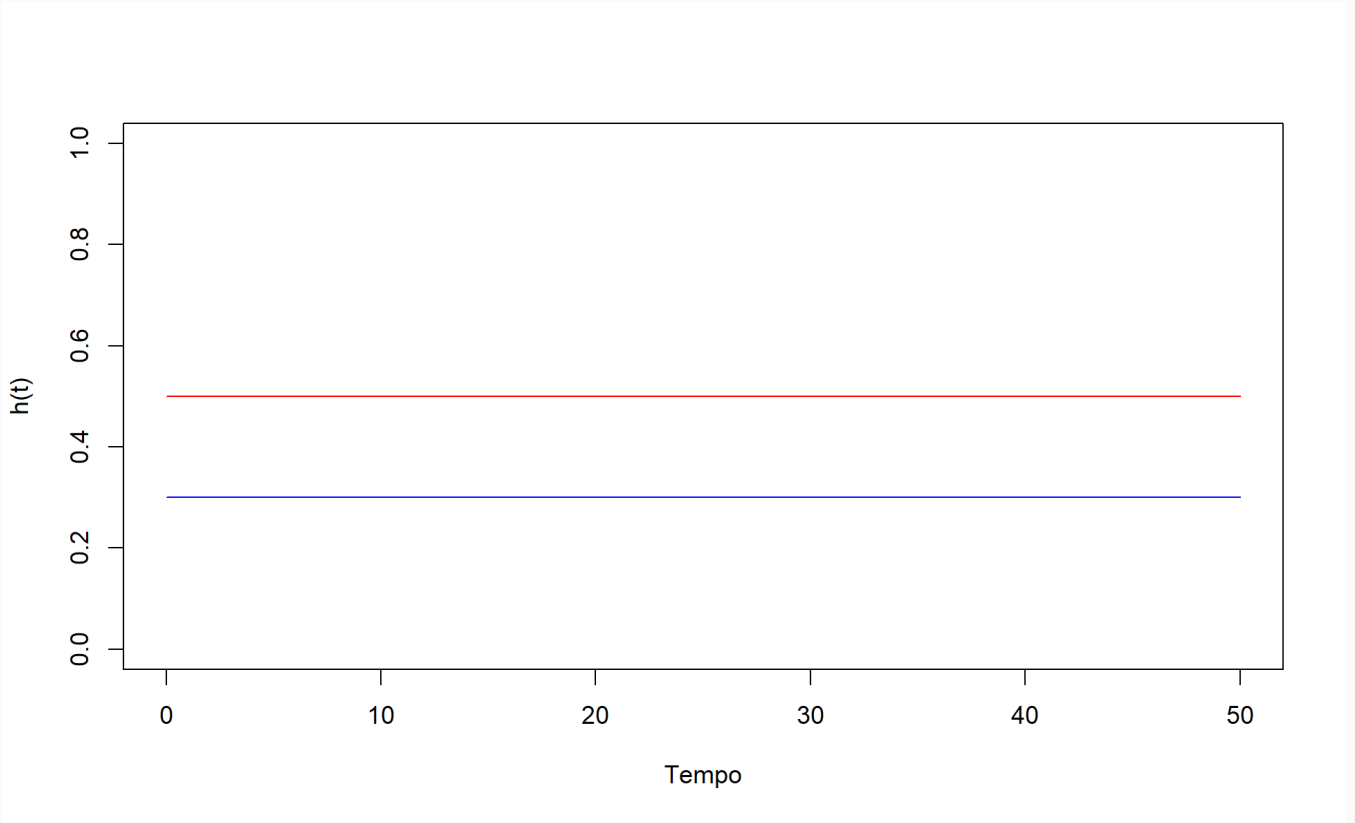
Modelos Paramétricos - Exponencial

```r
expHaz ← function(x, rate) {
  dexp(x, rate=rate)/
    pexp(x, rate=rate, lower.tail=F)
}
curve(expHaz(x, rate=0.5), from=0, to=50,
      ylab="h(t)", xlab="Tempo",
      col="red", ylim=c(0,1))
```



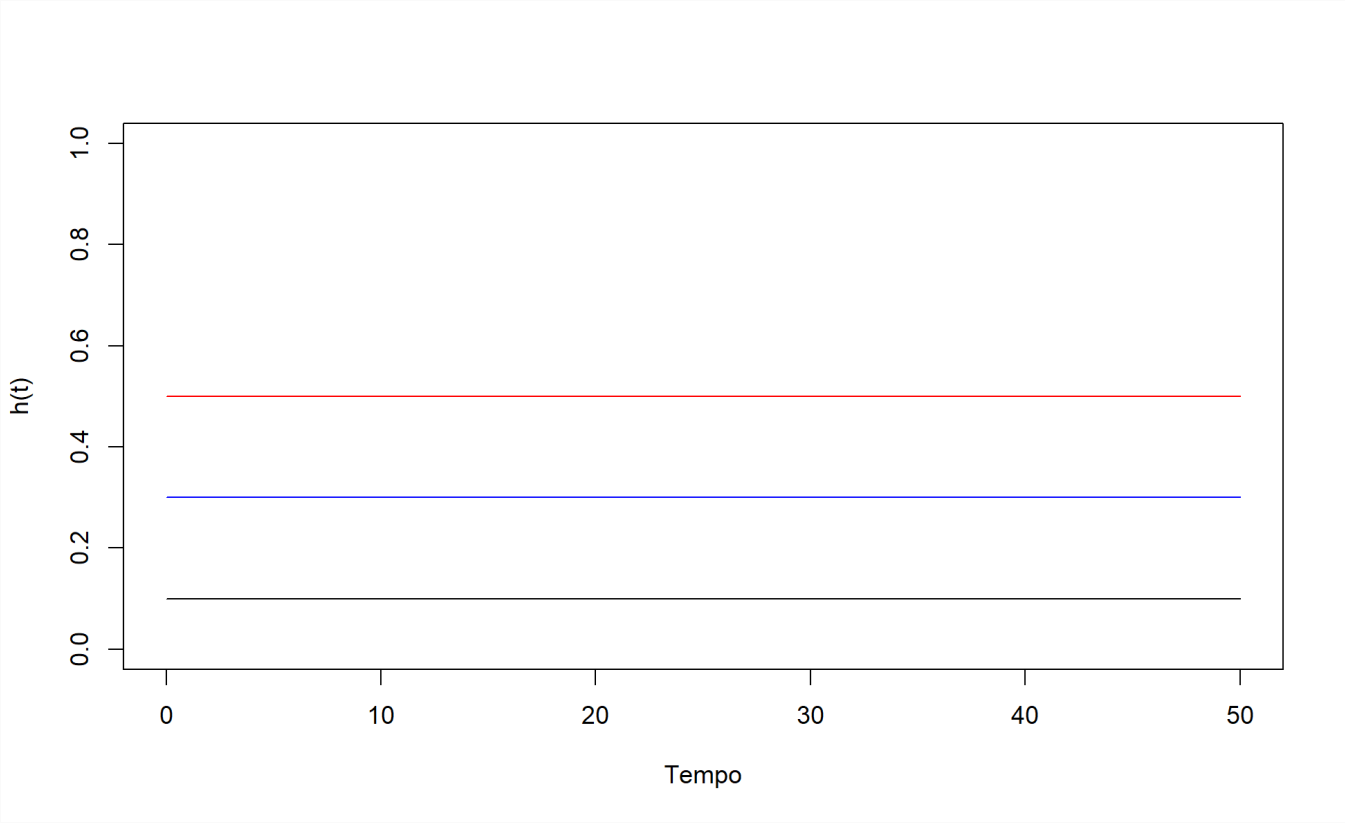
Modelos Paramétricos - Exponencial

```r
expHaz ← function(x, rate) {
  dexp(x, rate=rate)/
    pexp(x, rate=rate, lower.tail=F)
}
curve(expHaz(x, rate=0.5), from=0, to=50,
      ylab="h(t)", xlab="Tempo",
      col="red", ylim=c(0,1))
curve(expHaz(x, rate=0.3), from=0, to=50,
      ylab="h(t)", xlab="Tempo",
      col="blue", add = T)
```



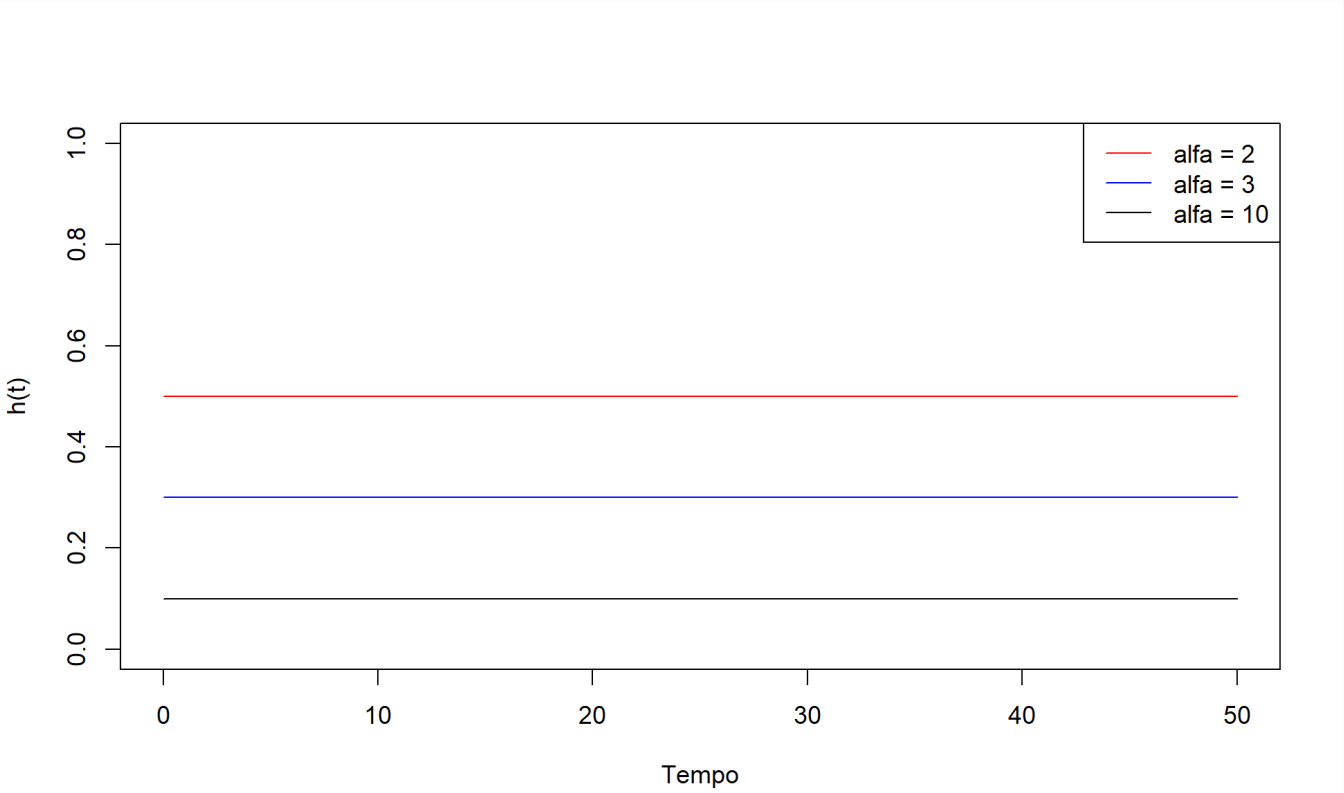
Modelos Paramétricos - Exponencial

```r
expHaz ← function(x, rate) {
  dexp(x, rate=rate)/
    pexp(x, rate=rate, lower.tail=F)
}
curve(expHaz(x, rate=0.5), from=0, to=50,
      ylab="h(t)", xlab="Tempo",
      col="red", ylim=c(0,1))
curve(expHaz(x, rate=0.3), from=0, to=50,
      ylab="h(t)", xlab="Tempo",
      col="blue", add = T)
curve(expHaz(x, rate=0.1), from=0, to=50,
      ylab="h(t)", xlab="Tempo",
      col="black", add=T)
```



Modelos Paramétricos - Exponencial

```
expHaz ← function(x, rate) {
  dexp(x, rate=rate)/
    pexp(x, rate=rate, lower.tail=F)
}
curve(expHaz(x, rate=0.5), from=0, to=50,
      ylab="h(t)", xlab="Tempo",
      col="red", ylim=c(0,1))
curve(expHaz(x, rate=0.3), from=0, to=50,
      ylab="h(t)", xlab="Tempo",
      col="blue", add = T)
curve(expHaz(x, rate=0.1), from=0, to=50,
      ylab="h(t)", xlab="Tempo",
      col="black", add=T)
legend("topright",
       legend = c(expression(paste(alfa, " = ", 2)),
                  expression(paste(alfa, " = ", 3)),
                  expression(paste(alfa, " = ", 10))),
                   lty=1, col = c("red","blue","black"))
```

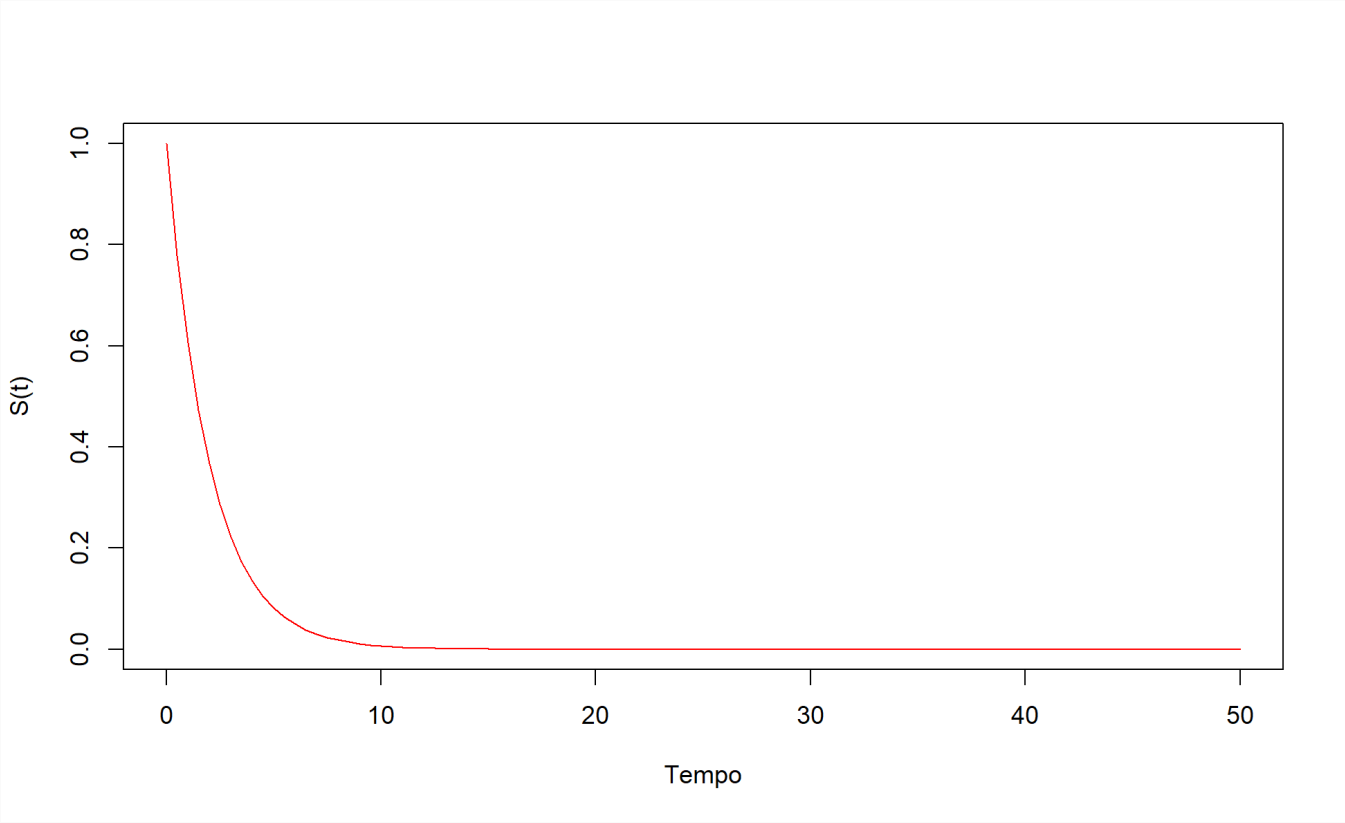


Modelos Paramétricos - Exponencial

```
expSurv ← function(x, rate) {
  pexp(x, rate=rate, lower.tail=F)
}
```

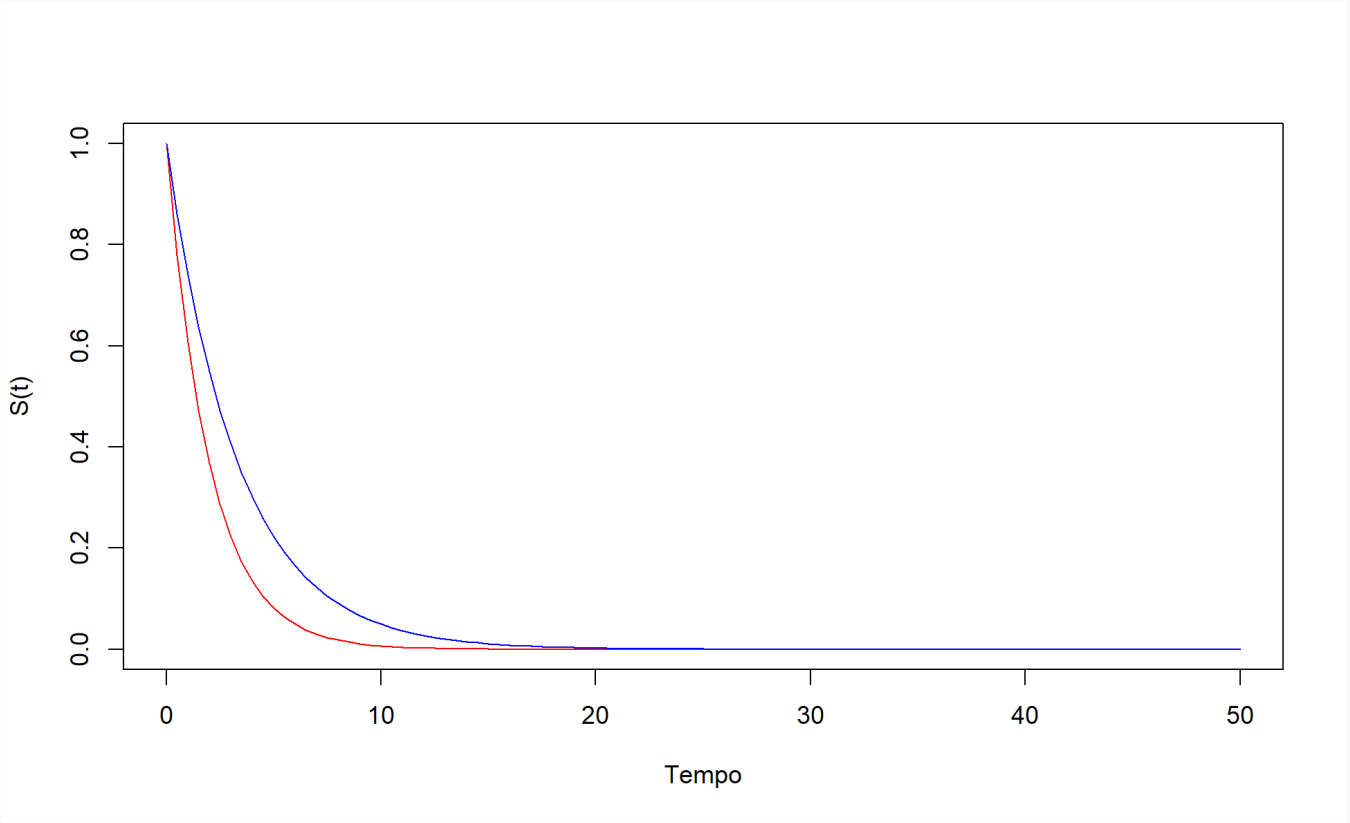
Modelos Paramétricos - Exponencial

```r
expSurv ← function(x, rate) {
  pexp(x, rate=rate, lower.tail=F)
}
curve(expSurv(x, rate=0.5), from=0, to=50,
      ylab="S(t)", xlab="Tempo", col="red")
```



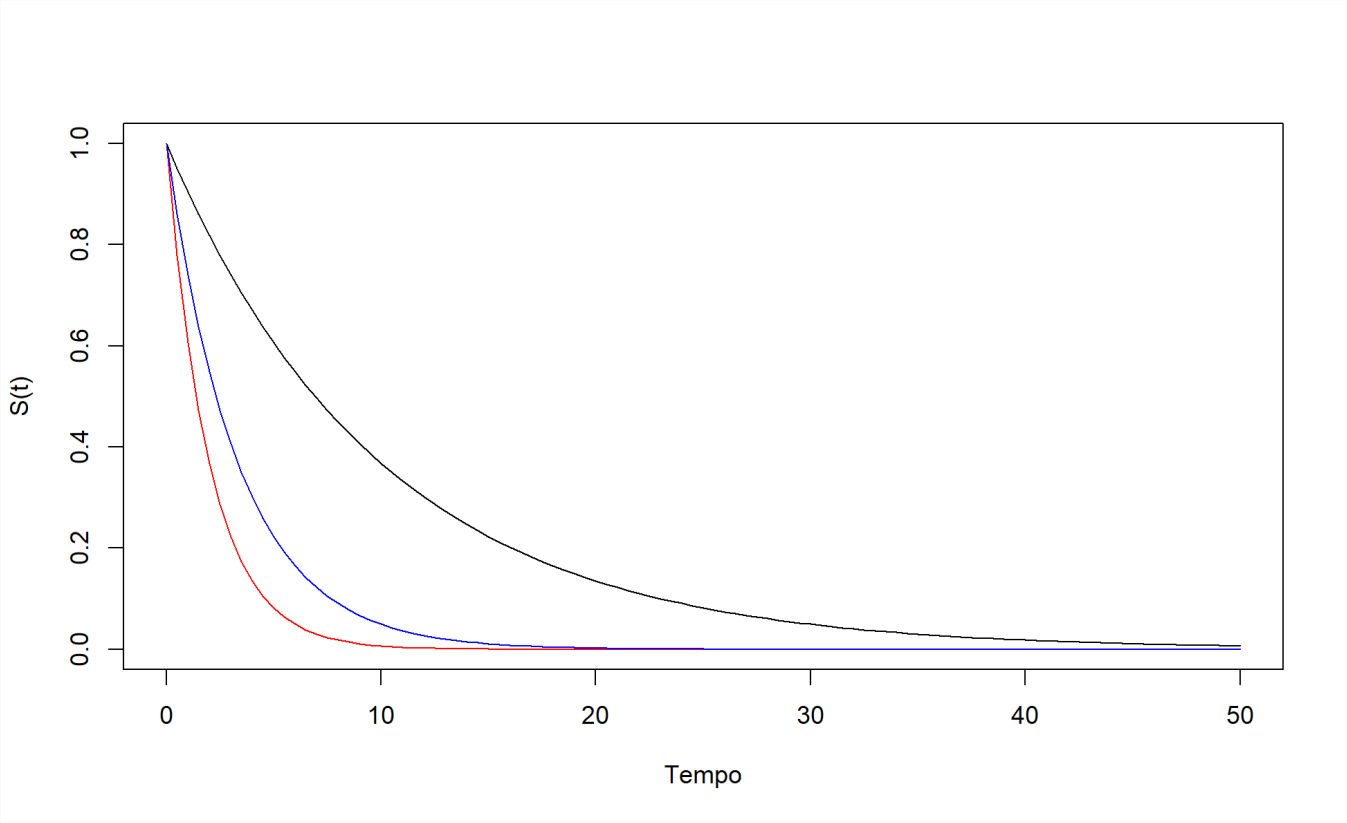
Modelos Paramétricos - Exponencial

```r
expSurv ← function(x, rate) {
  pexp(x, rate=rate, lower.tail=F)
}
curve(expSurv(x, rate=0.5), from=0, to=50,
      ylab="S(t)", xlab="Tempo", col="red")
curve(expSurv(x, rate=0.3), from=0, to=50,
      ylab="S(t)", xlab="Tempo", col="blue", add=T)
```



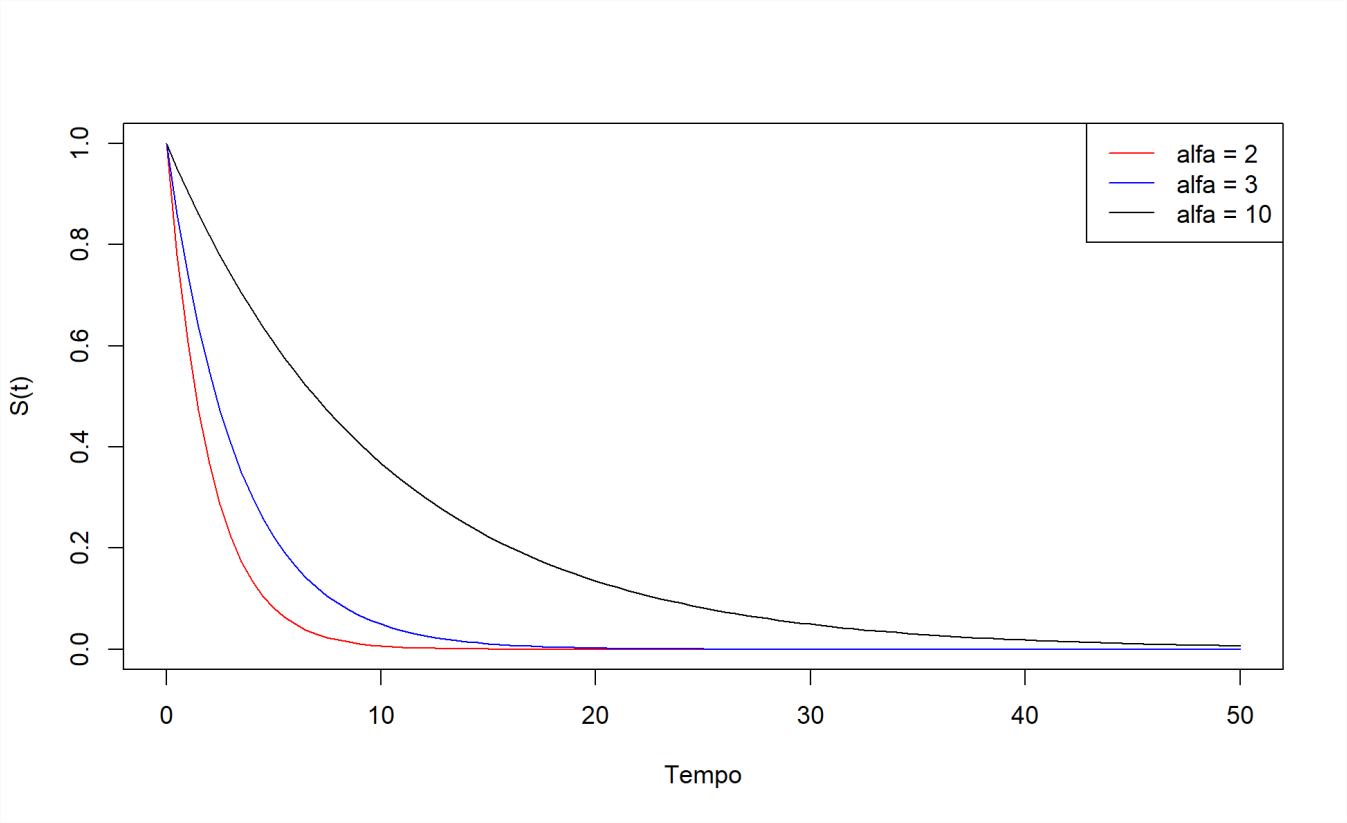
Modelos Paramétricos - Exponencial

```r
expSurv ← function(x, rate) {
  pexp(x, rate=rate, lower.tail=F)
}
curve(expSurv(x, rate=0.5), from=0, to=50,
      ylab="S(t)", xlab="Tempo", col="red")
curve(expSurv(x, rate=0.3), from=0, to=50,
      ylab="S(t)", xlab="Tempo", col="blue", add=T)
curve(expSurv(x, rate=0.1), from=0, to=50,
      ylab="S(t)", xlab="Tempo", col="black", add=T)
```



Modelos Paramétricos - Exponencial

```
expSurv ← function(x, rate) {
  pexp(x, rate=rate, lower.tail=F)
}
curve(expSurv(x, rate=0.5), from=0, to=50,
      ylab="S(t)", xlab="Tempo", col="red")
curve(expSurv(x, rate=0.3), from=0, to=50,
      ylab="S(t)", xlab="Tempo", col="blue", add=T)
curve(expSurv(x, rate=0.1), from=0, to=50,
      ylab="S(t)", xlab="Tempo", col="black", add=T)
legend("topright",
       legend = c(expression(paste(alfa, " = ", 2)),
                  expression(paste(alfa, " = ", 3)),
                  expression(paste(alfa, " = ", 10))),
       lty=1, col = c("red","blue","black"))
```

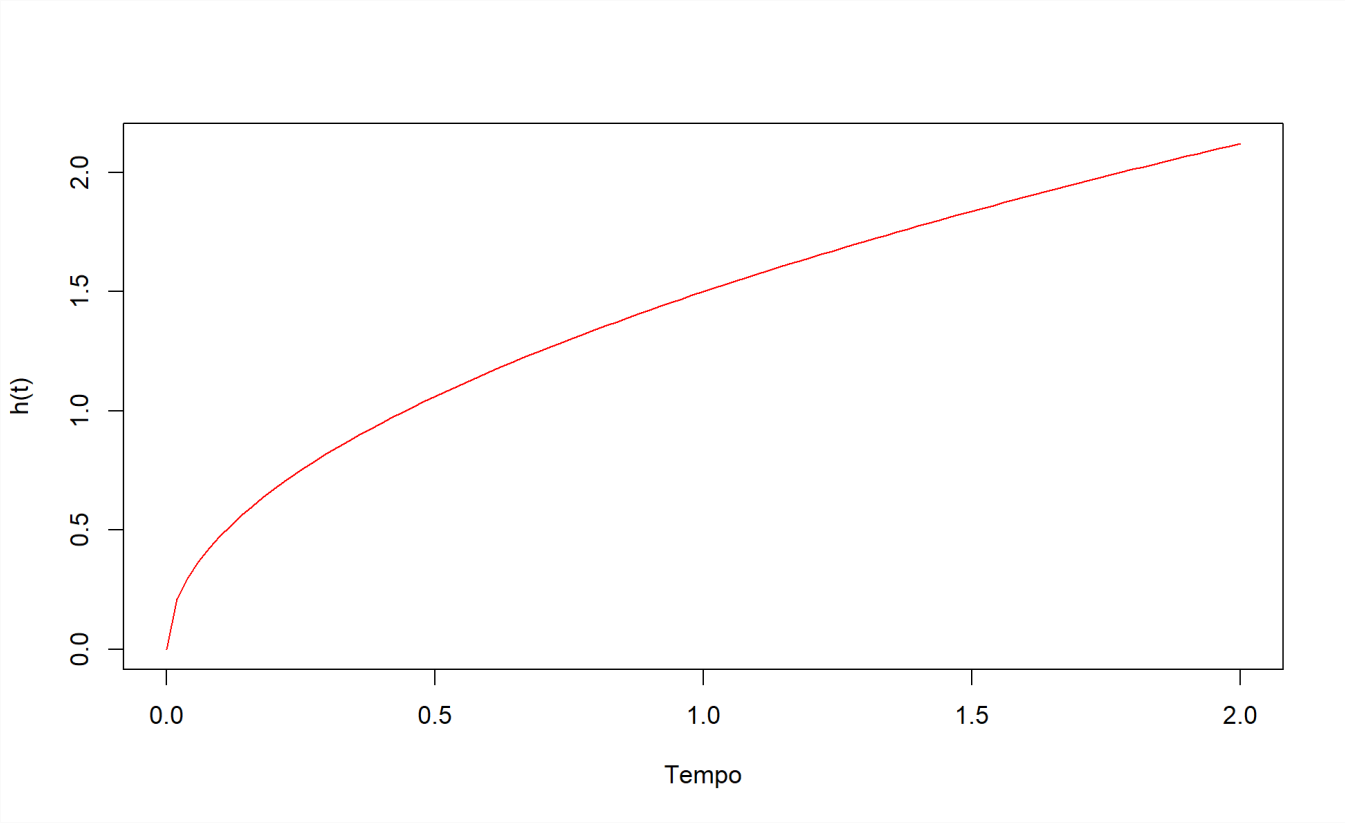


Modelos Paramétricos - Weibull

```
weibHaz ← function(x, shape, scale) {
  dweibull(x, shape=shape, scale=scale)/
  pweibull(x, shape=shape, scale=scale,
           lower.tail=F)
}
```

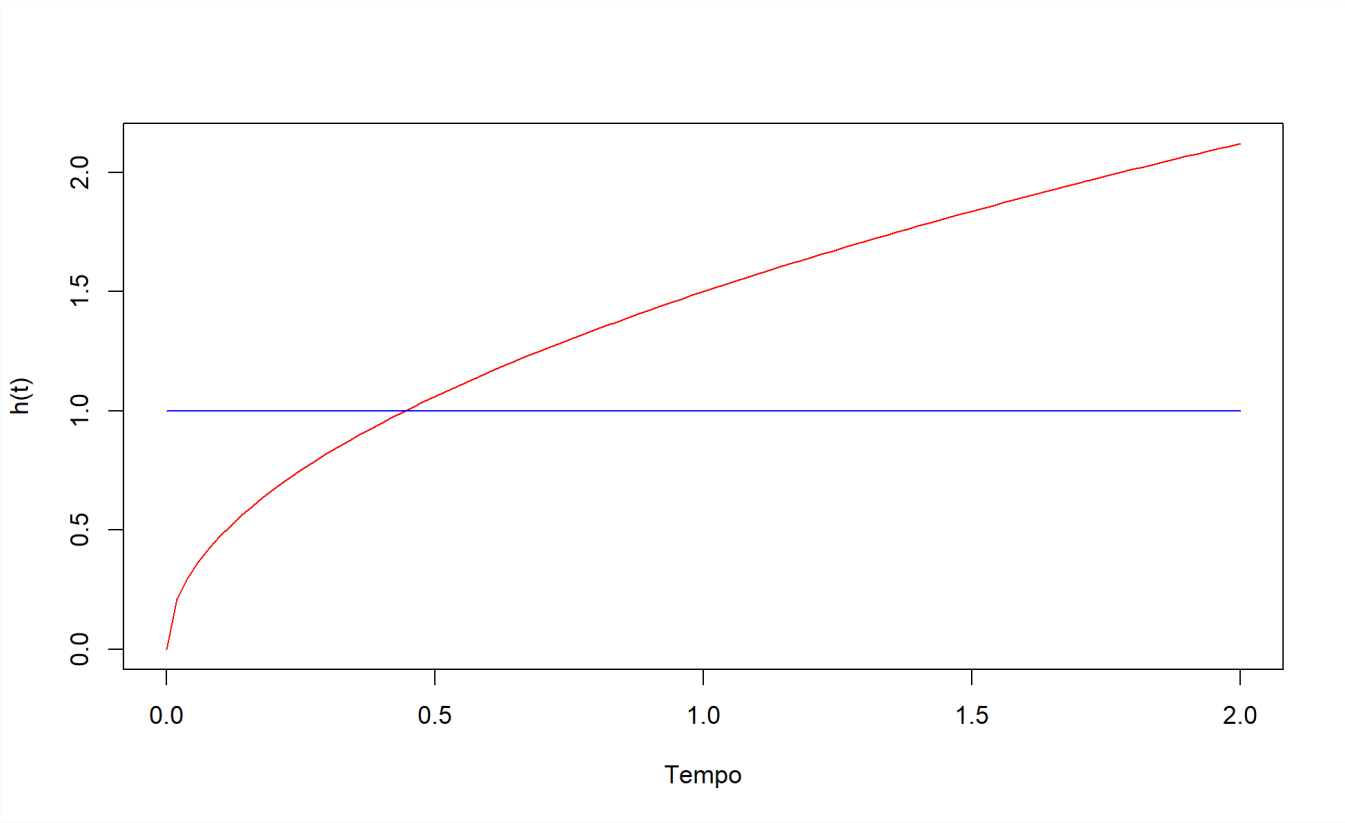
Modelos Paramétricos - Weibull

```r
weibHaz ← function(x, shape, scale) {
  dweibull(x, shape=shape, scale=scale)/
  pweibull(x, shape=shape, scale=scale,
           lower.tail=F)
}
curve(weibHaz(x, shape=1.5, scale=1),
      from=0, to=2,
      ylab="h(t)", xlab="Tempo", col="red")
```



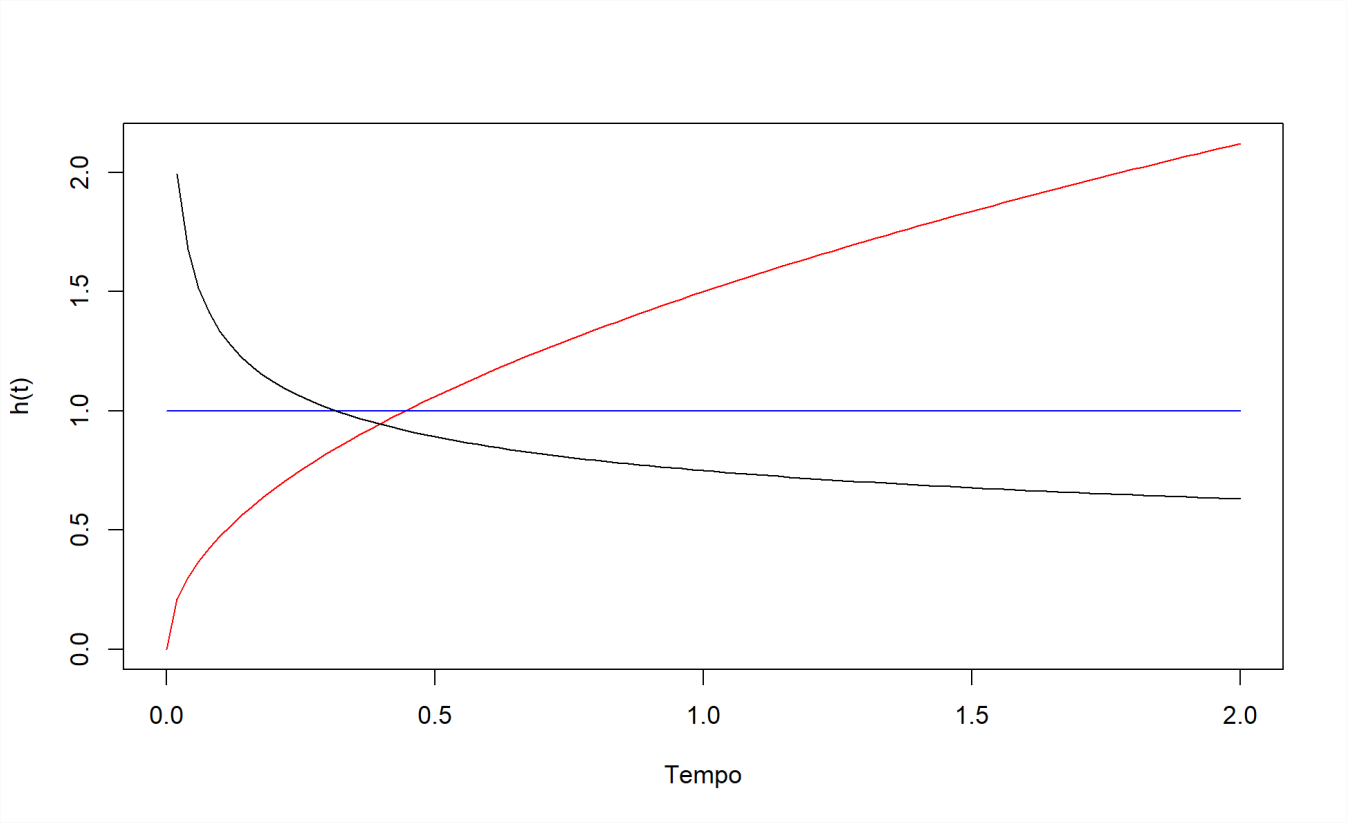
Modelos Paramétricos - Weibull

```r
weibHaz ← function(x, shape, scale) {
  dweibull(x, shape=shape, scale=scale)/
  pweibull(x, shape=shape, scale=scale,
           lower.tail=F)
}
curve(weibHaz(x, shape=1.5, scale=1),
      from=0, to=2,
      ylab="h(t)", xlab="Tempo", col="red")
curve(weibHaz(x, shape=1, scale=1),
      from=0, to=2,
      ylab="h(t)", xlab="Tempo", col="blue",
      add = T)
```



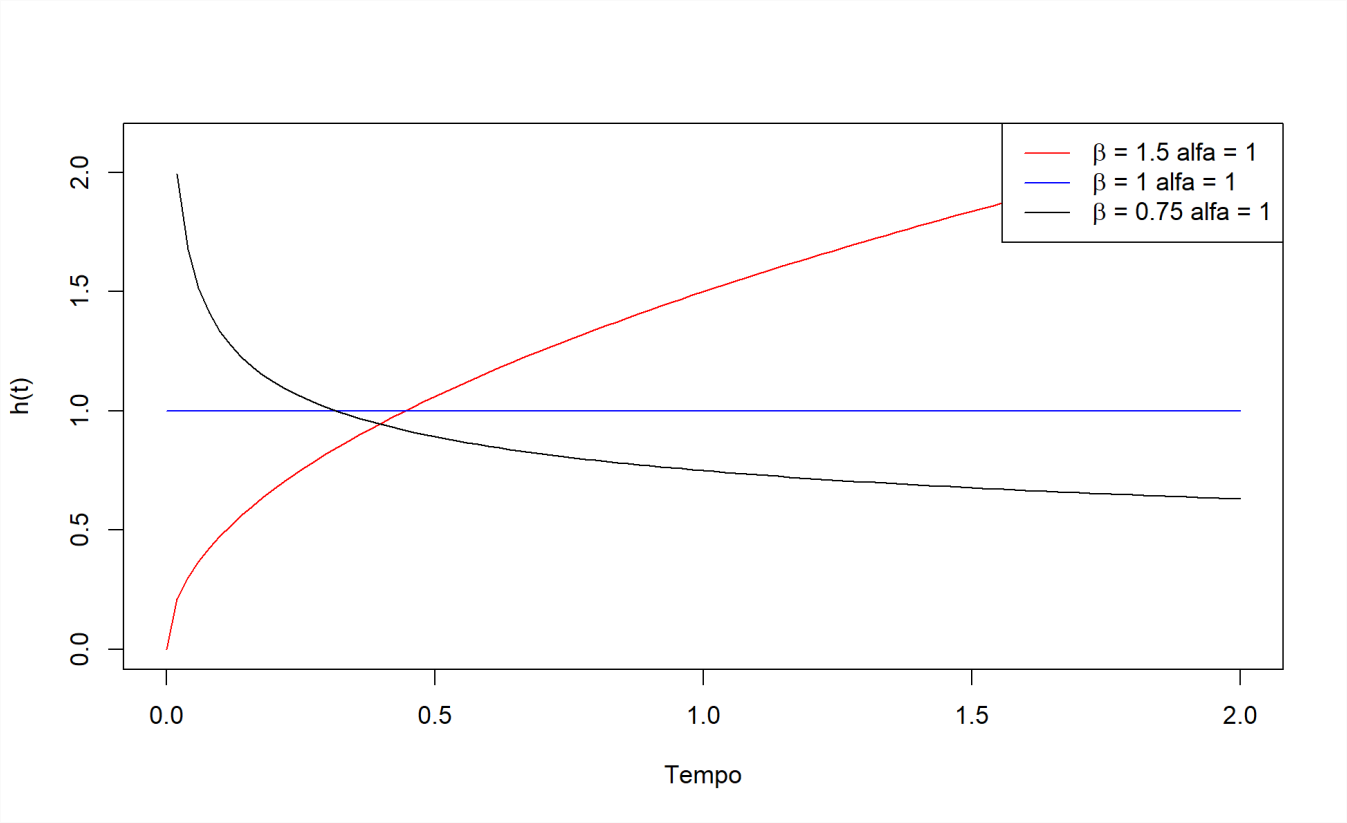
Modelos Paramétricos - Weibull

```r
weibHaz ← function(x, shape, scale) {
  dweibull(x, shape=shape, scale=scale)/
  pweibull(x, shape=shape, scale=scale,
           lower.tail=F)
}
curve(weibHaz(x, shape=1.5, scale=1),
      from=0, to=2,
      ylab="h(t)", xlab="Tempo", col="red")
curve(weibHaz(x, shape=1, scale=1),
      from=0, to=2,
      ylab="h(t)", xlab="Tempo", col="blue",
      add = T)
curve(weibHaz(x, shape=0.75, scale=1),
      from=0, to=2,
      ylab="h(t)", xlab="Tempo", col="black",
      add=T)
```



Modelos Paramétricos - Weibull

```
weibHaz ← function(x, shape, scale) {
  dweibull(x, shape=shape, scale=scale)/
  pweibull(x, shape=shape, scale=scale,
           lower.tail=F)
}
curve(weibHaz(x, shape=1.5, scale=1),
      from=0, to=2,
      ylab="h(t)", xlab="Tempo", col="red")
curve(weibHaz(x, shape=1, scale=1),
      from=0, to=2,
      ylab="h(t)", xlab="Tempo", col="blue",
      add = T)
curve(weibHaz(x, shape=0.75, scale=1),
      from=0, to=2,
      ylab="h(t)", xlab="Tempo", col="black",
      add=T)
legend("topright",
   legend = c(expression(paste(beta, " = ", 1.5," ",
                               alfa, " = ", 1)),
              expression(paste(beta, " = ", 1," ",
                               alfa, " = ", 1)),
              expression(paste(beta, " = ", 0.75," ",
                               alfa, " = ", 1))),
       lty=1, col = c("red","blue","black"))
```

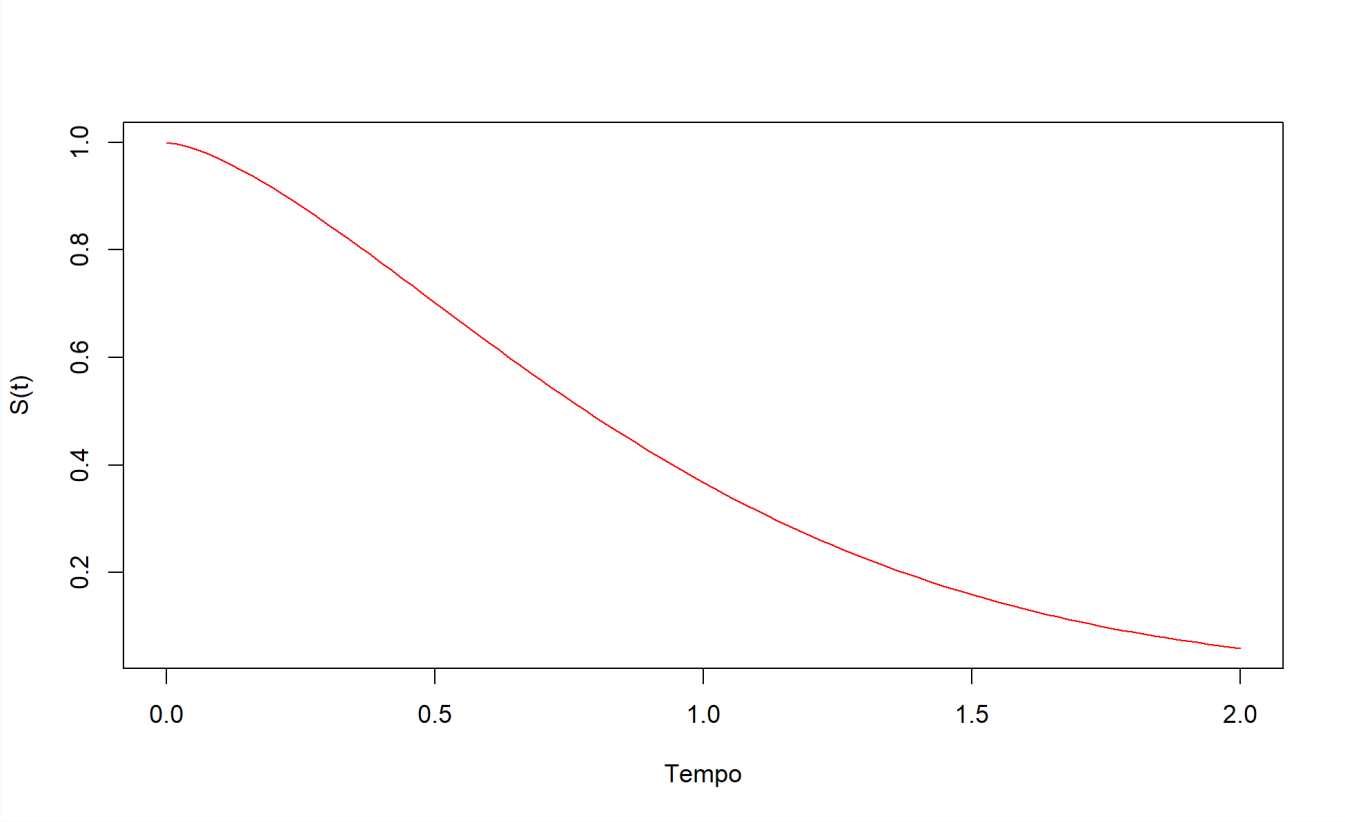


Modelos Paramétricos - Weibull

```
weibSurv ← function(x, shape, scale) {
  pweibull(x, shape=shape, scale=scale,
           lower.tail=F)
}
```

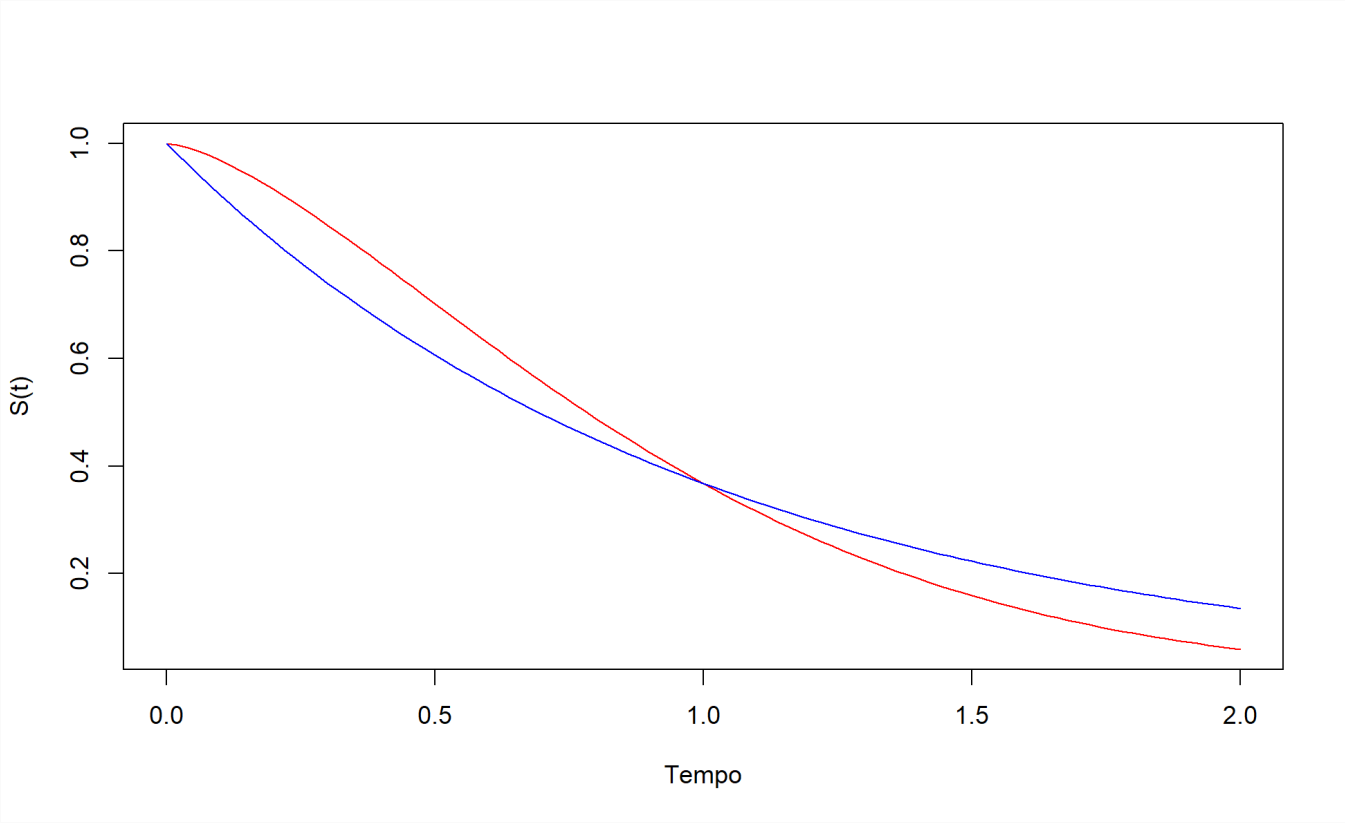
Modelos Paramétricos - Weibull

```r
weibSurv ← function(x, shape, scale) {
  pweibull(x, shape=shape, scale=scale,
           lower.tail=F)
}
curve(weibSurv(x, shape=1.5, scale=1), from=0, to=2,
      ylab="S(t)", xlab="Tempo", col="red")
```



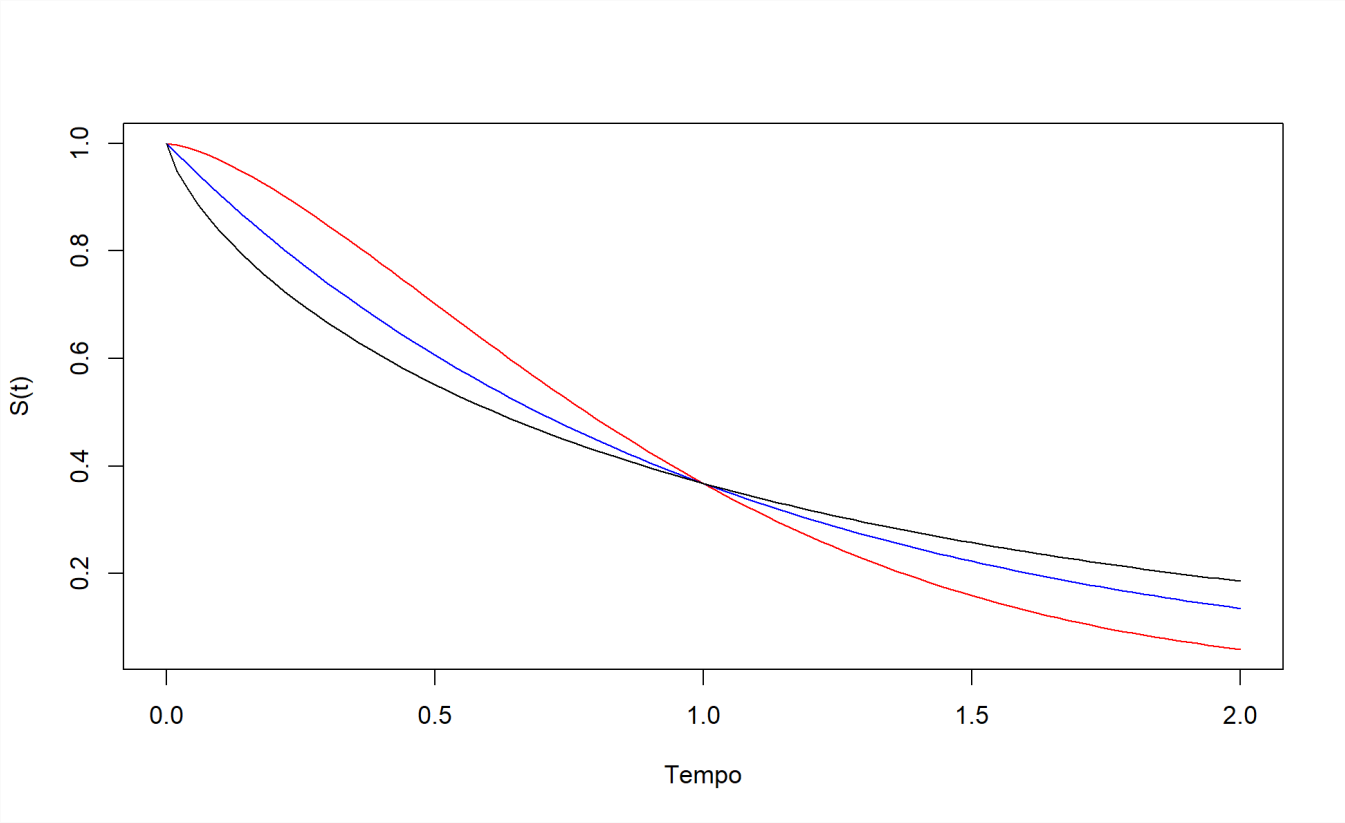
Modelos Paramétricos - Weibull

```r
weibSurv ← function(x, shape, scale) {
  pweibull(x, shape=shape, scale=scale,
           lower.tail=F)
}
curve(weibSurv(x, shape=1.5, scale=1), from=0, to=2,
      ylab="S(t)", xlab="Tempo", col="red")
curve(weibSurv(x, shape=1, scale=1), from=0, to=2,
      ylab="S(t)", xlab="Tempo", col="blue", add=T)
```



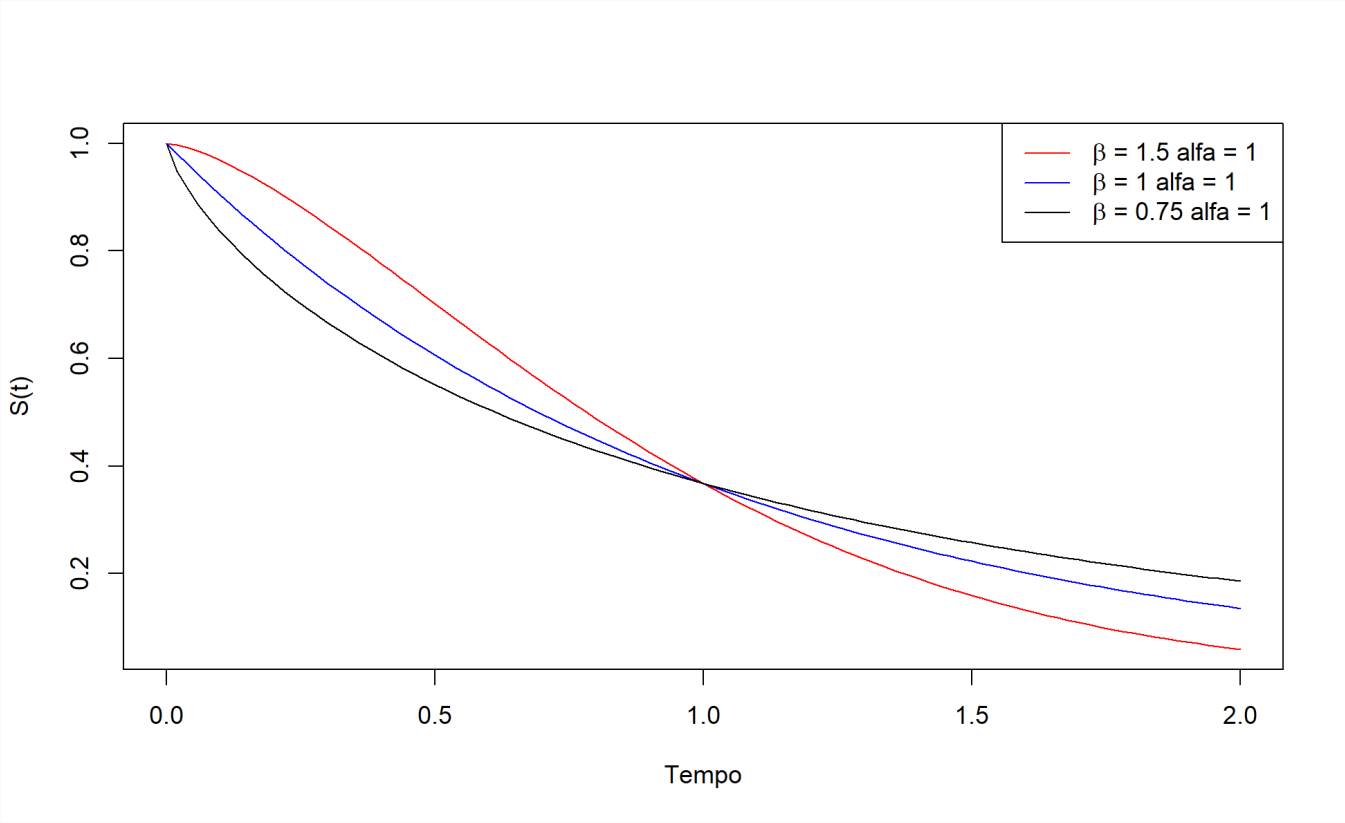
Modelos Paramétricos - Weibull

```
weibSurv ← function(x, shape, scale) {
  pweibull(x, shape=shape, scale=scale,
           lower.tail=F)
}
curve(weibSurv(x, shape=1.5, scale=1), from=0, to=2,
      ylab="S(t)", xlab="Tempo", col="red")
curve(weibSurv(x, shape=1, scale=1), from=0, to=2,
      ylab="S(t)", xlab="Tempo", col="blue", add=T)
curve(weibSurv(x, shape=0.75, scale=1), from=0, to=2,
      ylab="S(t)", xlab="Tempo", col="black", add=T)
```



Modelos Paramétricos - Weibull

```
weibSurv ← function(x, shape, scale) {
  pweibull(x, shape=shape, scale=scale,
           lower.tail=F)
}
curve(weibSurv(x, shape=1.5, scale=1), from=0, to=2,
      ylab="S(t)", xlab="Tempo", col="red")
curve(weibSurv(x, shape=1, scale=1), from=0, to=2,
      ylab="S(t)", xlab="Tempo", col="blue", add=T)
curve(weibSurv(x, shape=0.75, scale=1), from=0, to=2,
      ylab="S(t)", xlab="Tempo", col="black", add=T)
legend("topright",
       legend = c(expression(paste(beta, " = ", 1.5," ",
                                   alfa, " = ", 1)),
                                   alfa, " = ", 1)),
         expression(paste(beta, " = ", 0.75," ",
                                  alfa, " = ", 1))),
       lty=1, col = c("red","blue","black"))
```

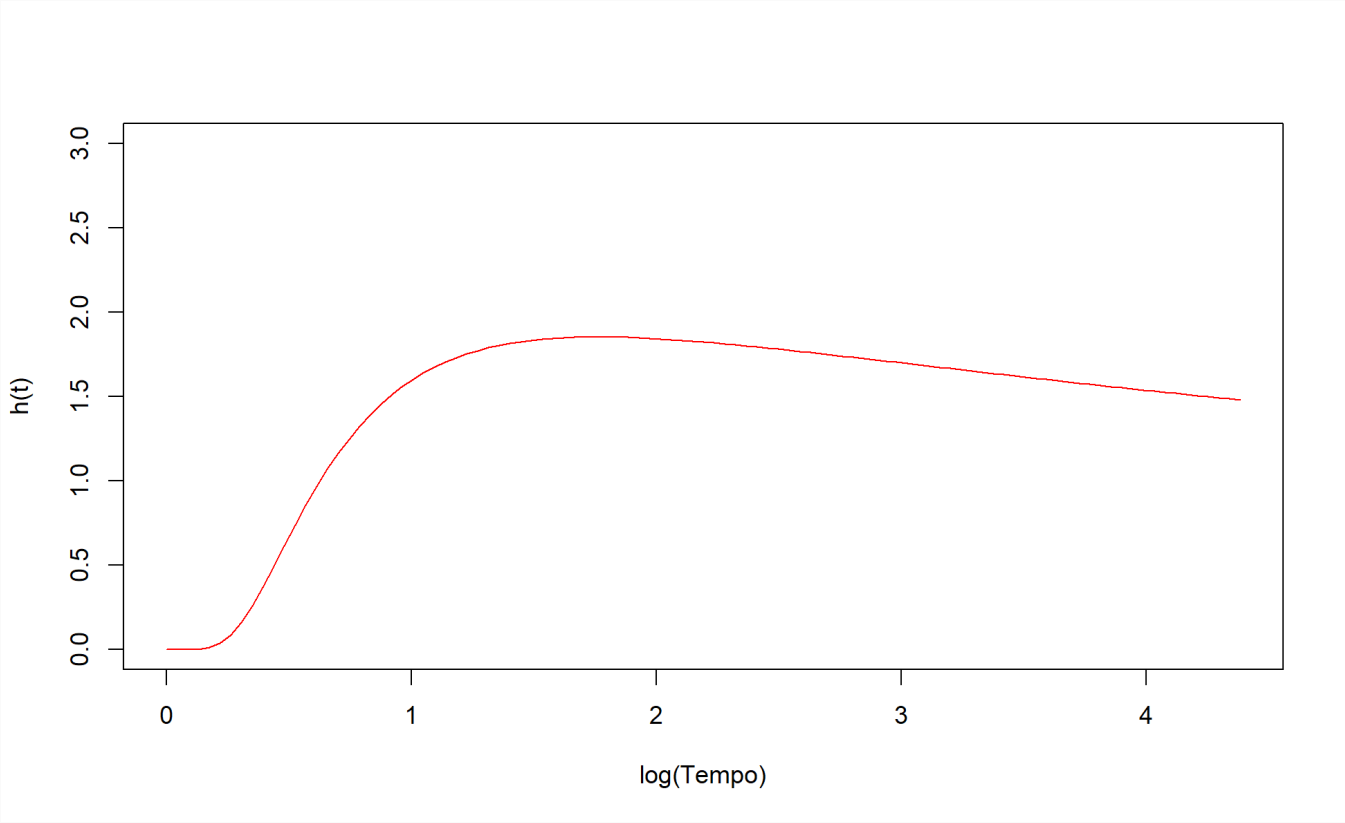


Modelos Paramétricos - Lognormal

```
logHaz ← function(x, meanlog, sdlog) {
  dlnorm(x, meanlog=meanlog, sdlog=sdlog)/
  plnorm(x, meanlog=meanlog, sdlog=sdlog,
         lower.tail=F)
}
```

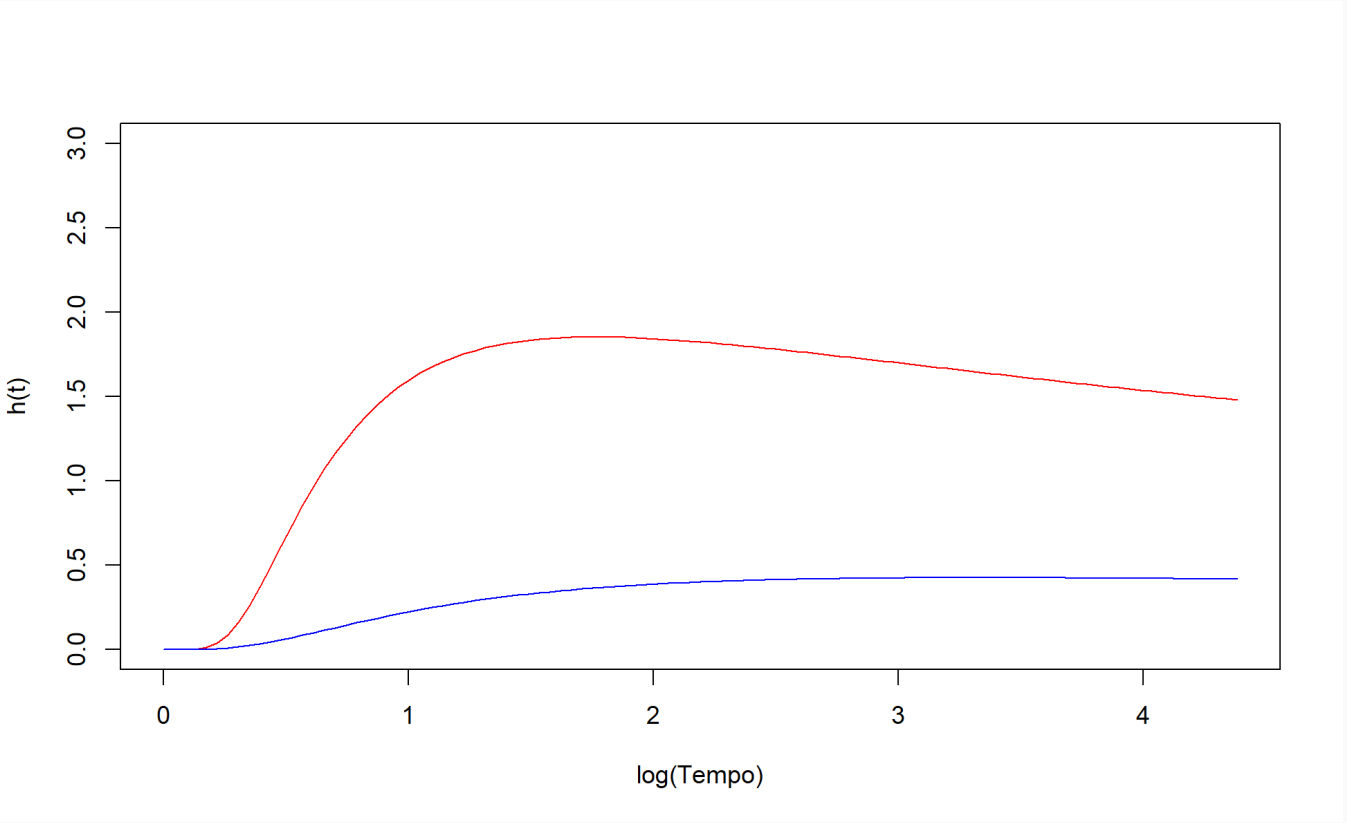
Modelos Paramétricos - Lognormal

```r
logHaz <- function(x, meanlog, sdlog) {
  dlnorm(x, meanlog=meanlog, sdlog=sdlog)/
  plnorm(x, meanlog=meanlog, sdlog=sdlog,
         lower.tail=F)
}
curve(logHaz(x, meanlog=0, sdlog=0.5), from=0, to=log(80
      ylab="h(t)", xlab="log(Tempo)",
      col="red", ylim=c(0,3.0))
```



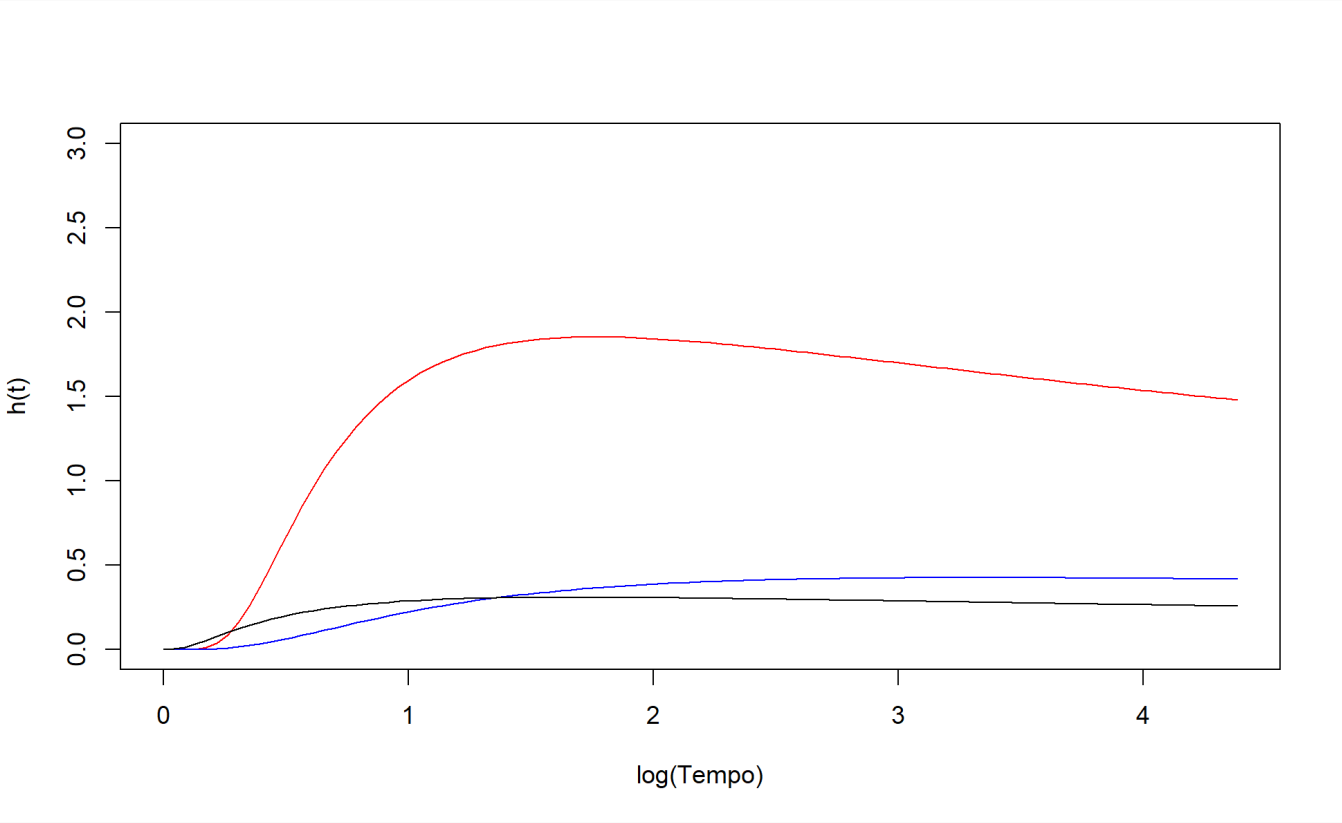
Modelos Paramétricos - Lognormal

```r
logHaz ← function(x, meanlog, sdlog) {
  dlnorm(x, meanlog=meanlog, sdlog=sdlog)/
  plnorm(x, meanlog=meanlog, sdlog=sdlog,
         lower.tail=F)
}
curve(logHaz(x, meanlog=0, sdlog=0.5), from=0, to=log(80
      ylab="h(t)", xlab="log(Tempo)",
      col="red", ylim=c(0,3.0))
curve(logHaz(x, meanlog=1, sdlog=0.7), from=0, to=log(80
      ylab="h(t)", xlab="Log(Tempo)",
      col="blue", add=T)
```



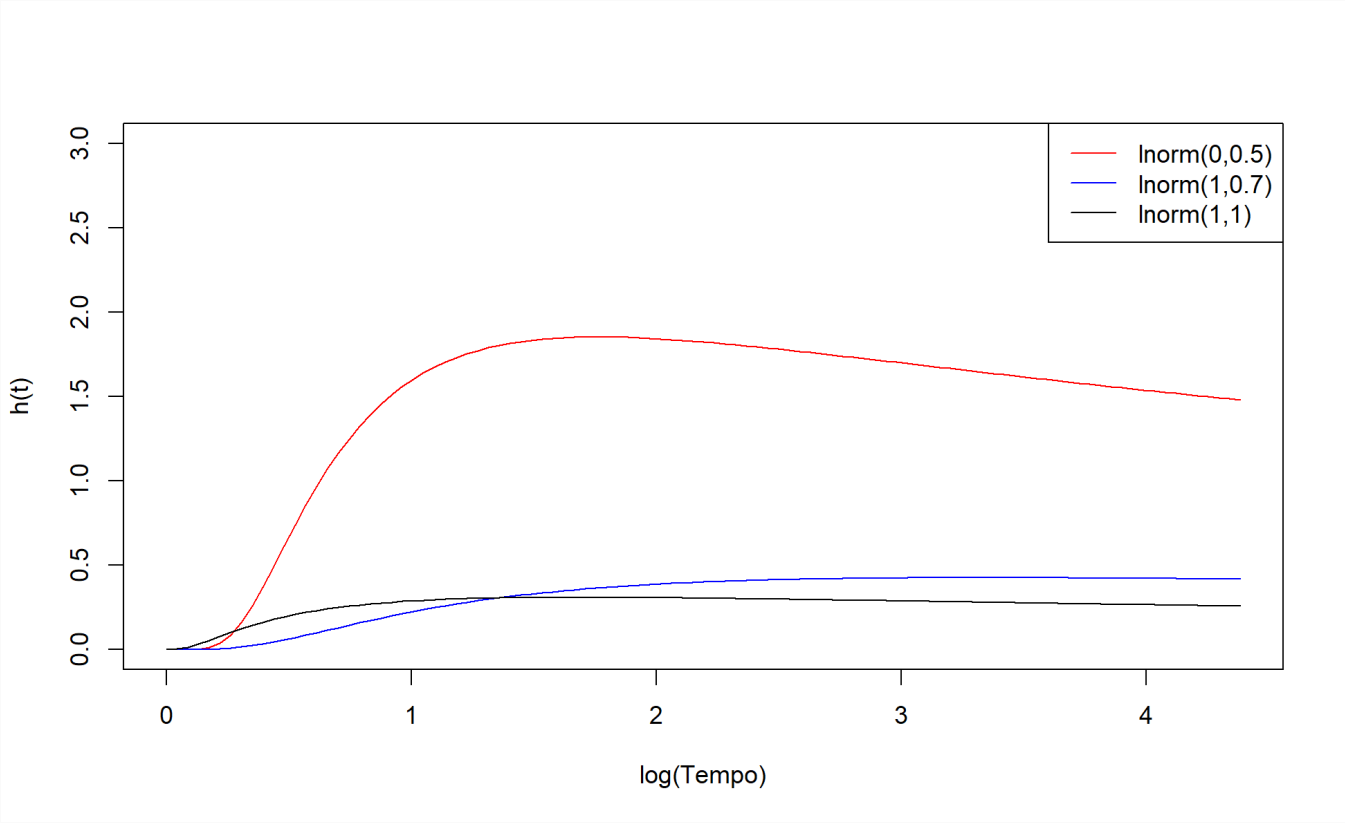
Modelos Paramétricos - Lognormal

```
logHaz ← function(x, meanlog, sdlog) {
  dlnorm(x, meanlog=meanlog, sdlog=sdlog)/
  plnorm(x, meanlog=meanlog, sdlog=sdlog,
         lower.tail=F)
}
curve(logHaz(x, meanlog=0, sdlog=0.5), from=0, to=log(80
      ylab="h(t)", xlab="log(Tempo)",
      col="red", ylim=c(0,3.0))
curve(logHaz(x, meanlog=1, sdlog=0.7), from=0, to=log(80
      ylab="h(t)", xlab="Log(Tempo)",
      col="blue", add=T)
curve(logHaz(x, meanlog=1, sdlog=1.0), from=0, to=log(80
      ylab="h(t)", xlab="Log(Tempo)",
      col="black", add=T)
```



Modelos Paramétricos - Lognormal

```
logHaz ← function(x, meanlog, sdlog) {
  dlnorm(x, meanlog=meanlog, sdlog=sdlog)/
  plnorm(x, meanlog=meanlog, sdlog=sdlog,
         lower.tail=F)
}
curve(logHaz(x, meanlog=0, sdlog=0.5), from=0, to=log(80
      ylab="h(t)", xlab="log(Tempo)",
      col="red", ylim=c(0,3.0))
curve(logHaz(x, meanlog=1, sdlog=0.7), from=0, to=log(80
      ylab="h(t)", xlab="Log(Tempo)",
      col="blue", add=T)
curve(logHaz(x, meanlog=1, sdlog=1.0), from=0, to=log(80
      ylab="h(t)", xlab="Log(Tempo)",
      col="black", add=T)
legend("topright", c("lnorm(0,0.5)", "lnorm(1,0.7)",
                     "lnorm(1,1)"), lty=1,
       col = c("red","blue","black"))
```

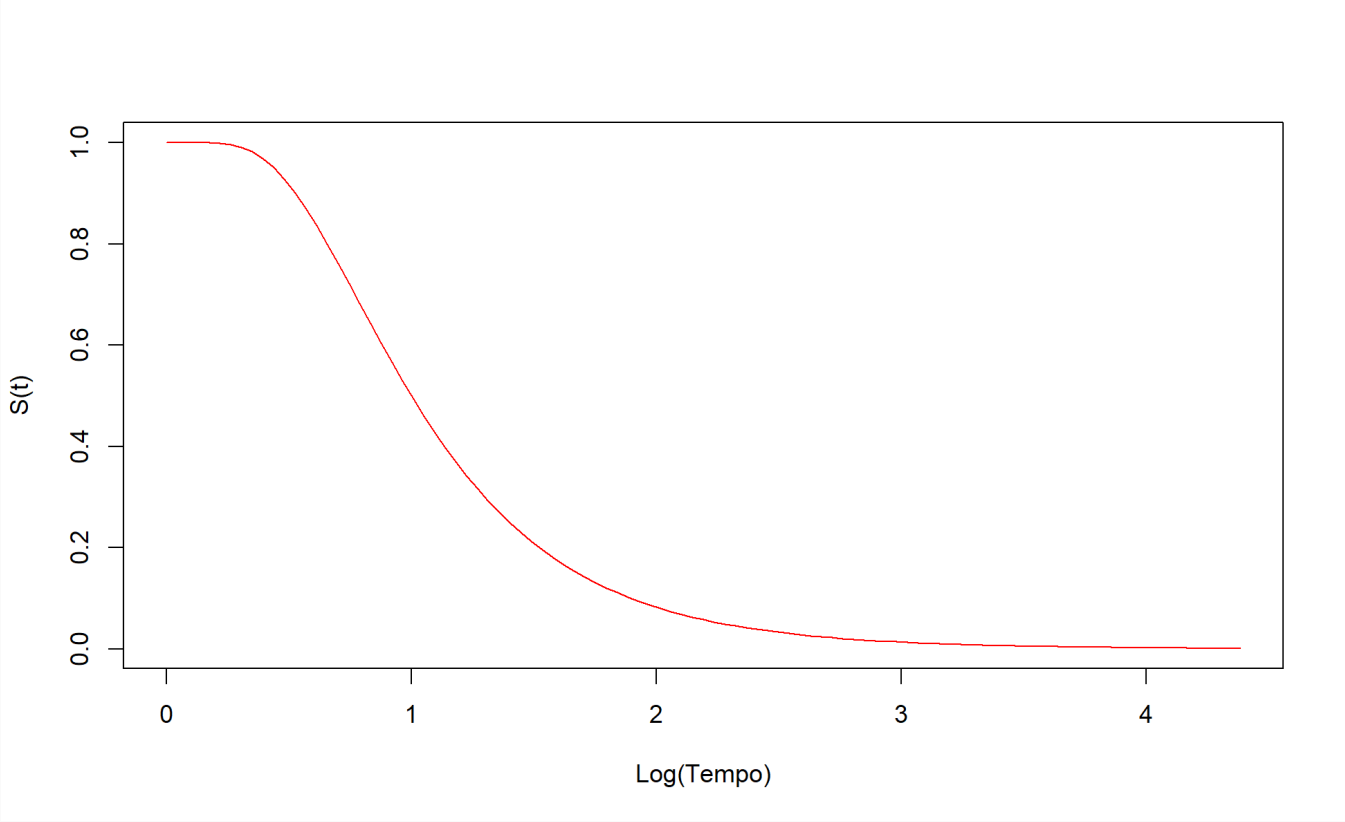


Modelos Paramétricos - Lognormal

```
logSurv ← function(x, meanlog, sdlog) {
  plnorm(x, meanlog=meanlog, sdlog=sdlog,
         lower.tail=F)
}
```

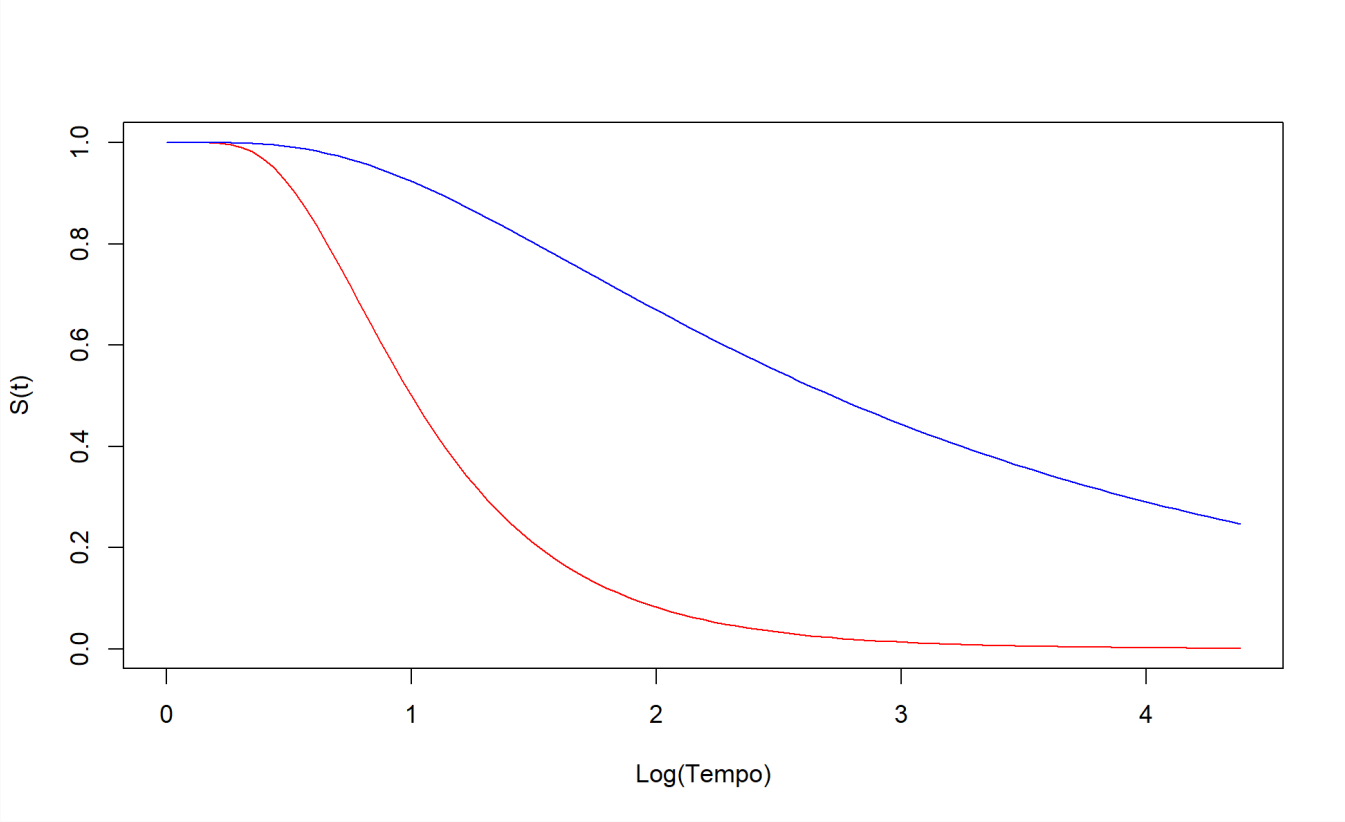
Modelos Paramétricos - Lognormal

```r
logSurv ← function(x, meanlog, sdlog) {
  plnorm(x, meanlog=meanlog, sdlog=sdlog,
         lower.tail=F)
}
curve(logSurv(x, meanlog=0, sdlog=0.5),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="red")
```



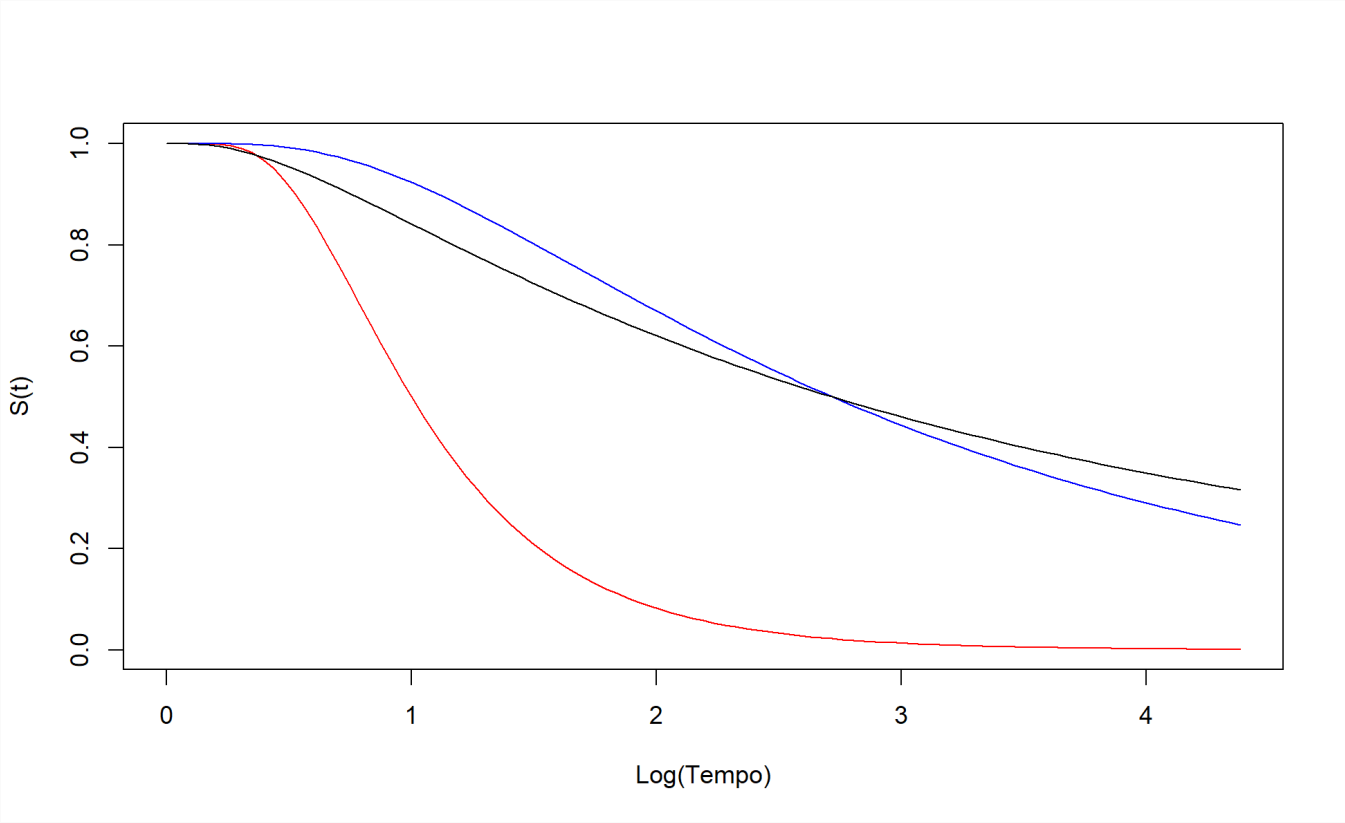
Modelos Paramétricos - Lognormal

```r
logSurv ← function(x, meanlog, sdlog) {
  plnorm(x, meanlog=meanlog, sdlog=sdlog,
         lower.tail=F)
}
curve(logSurv(x, meanlog=0, sdlog=0.5),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="red")
curve(logSurv(x, meanlog=1, sdlog=0.7),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="blue", add=T)
```



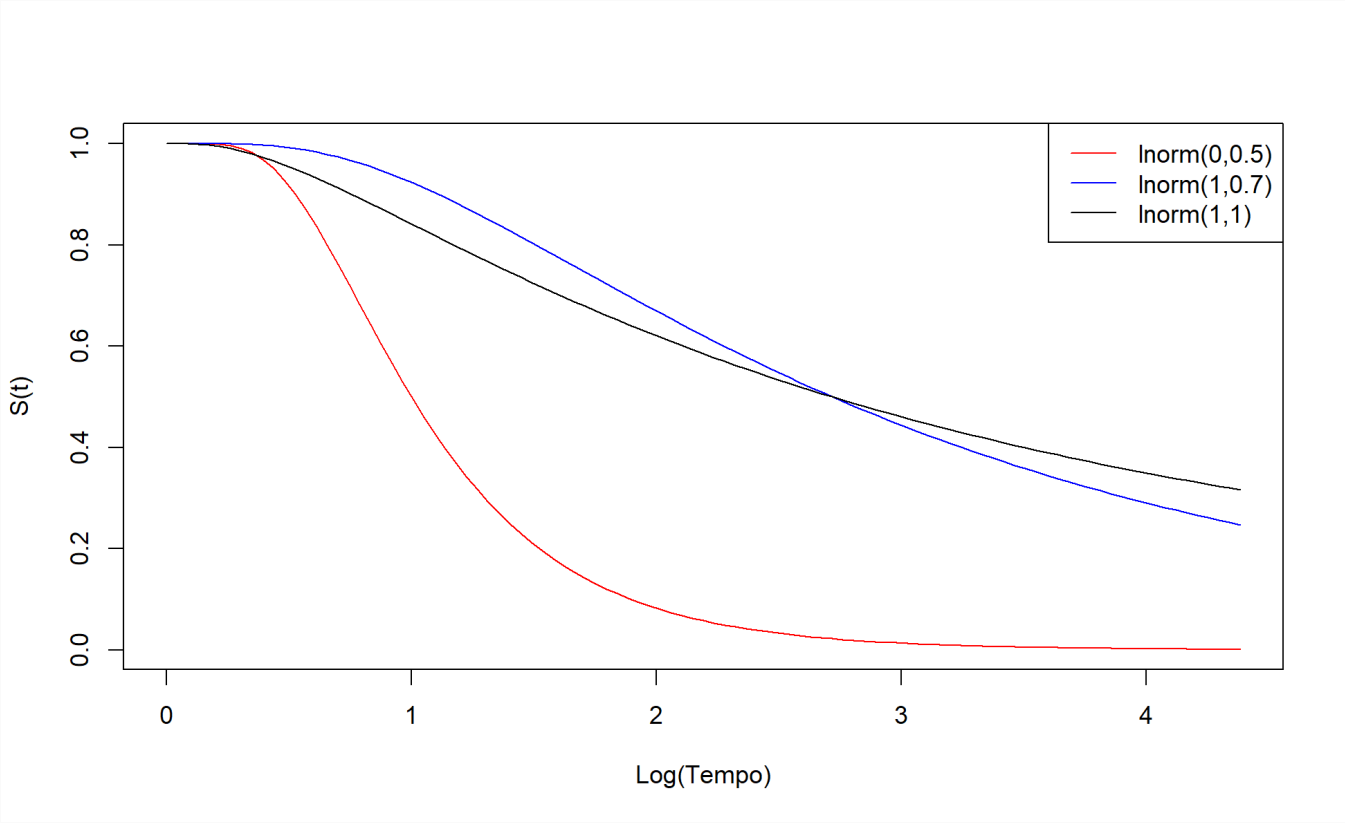
Modelos Paramétricos - Lognormal

```r
logSurv ← function(x, meanlog, sdlog) {
  plnorm(x, meanlog=meanlog, sdlog=sdlog,
         lower.tail=F)
}
curve(logSurv(x, meanlog=0, sdlog=0.5),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="red")
curve(logSurv(x, meanlog=1, sdlog=0.7),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="blue", add=T)
curve(logSurv(x, meanlog=1, sdlog=1.0),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="black", add=T)
```



Modelos Paramétricos - Lognormal

```
logSurv ← function(x, meanlog, sdlog) {
  plnorm(x, meanlog=meanlog, sdlog=sdlog,
         lower.tail=F)
}
curve(logSurv(x, meanlog=0, sdlog=0.5),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="red")
curve(logSurv(x, meanlog=1, sdlog=0.7),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="blue", add=T)
curve(logSurv(x, meanlog=1, sdlog=1.0),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="black", add=T)
legend("topright", c("lnorm(0,0.5)",
                     "lnorm(1,0.7)",
                     "lnorm(1,1)"),
       lty=1, col = c("red","blue","black"))
```

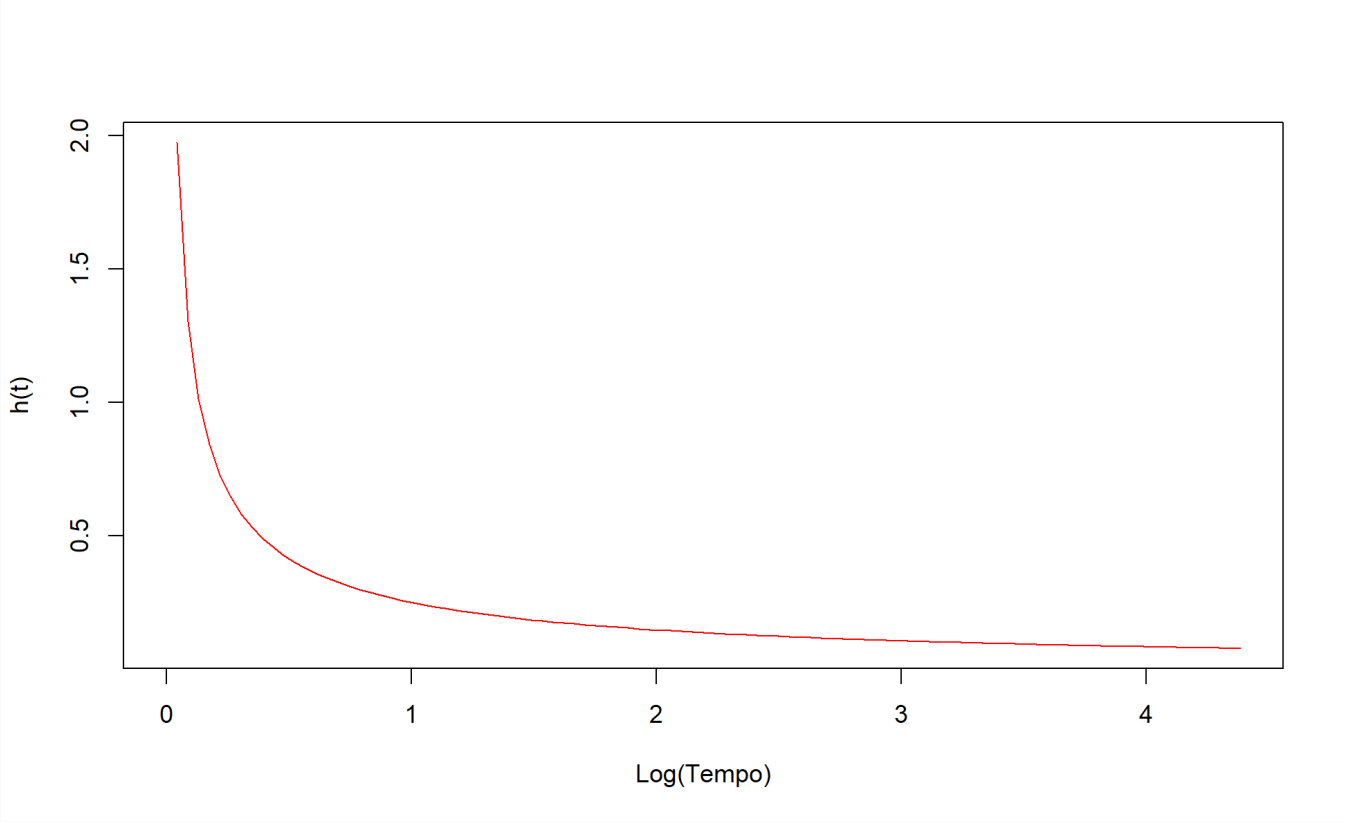


Modelos Paramétricos - Log-Logística

```
llogisHaz ← function(x, alfa, beta) {
  haz ← beta/alfa*(x/alfa)^(beta-1)/(1+(x/alfa)^beta)
}
```

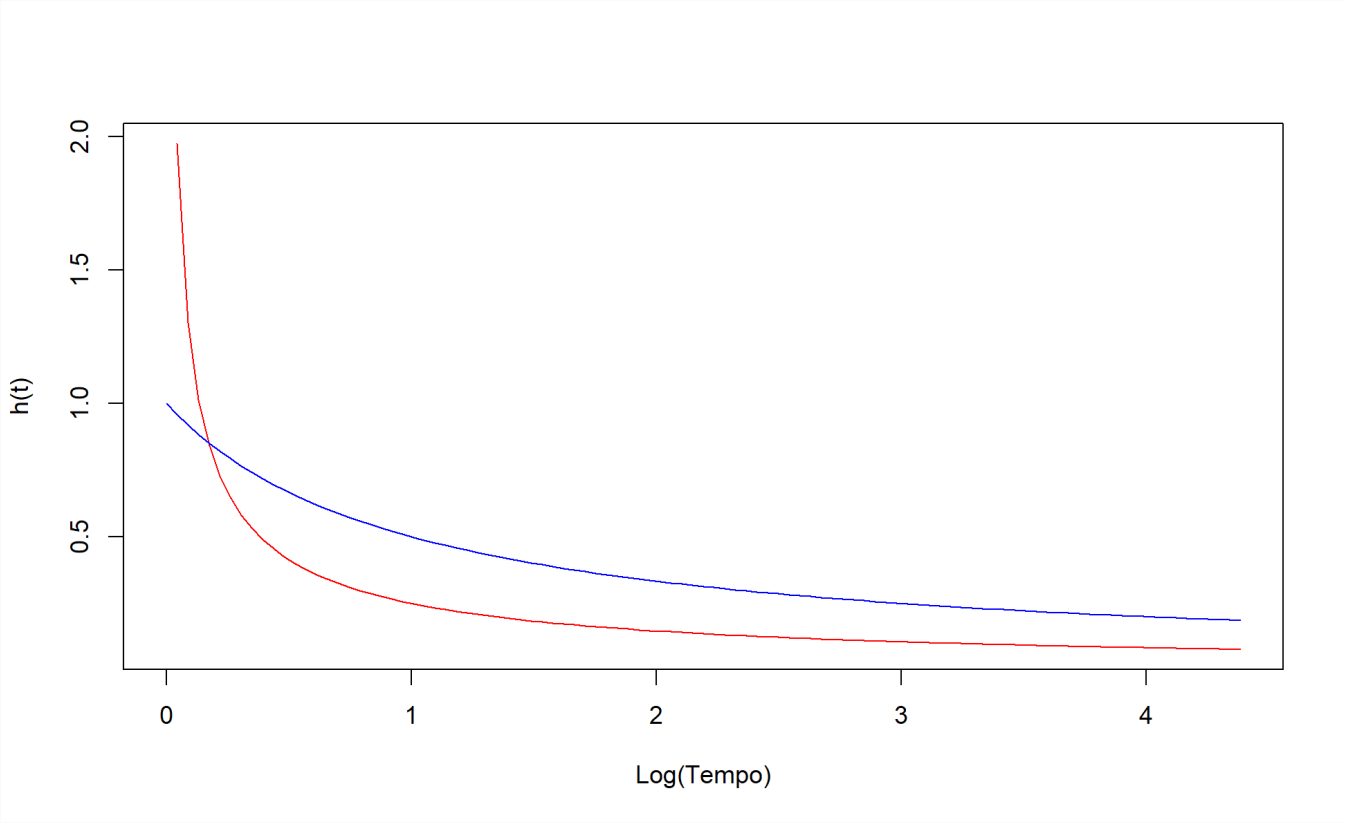
Modelos Paramétricos - Log-Logística

```r
llogisHaz ← function(x, alfa, beta) {
  haz ← beta/alfa*(x/alfa)^(beta-1)/(1+(x/alfa)^beta)
}
curve(llogisHaz(x, alfa=1, beta=0.5), from=0, to=log(80)
      ylab="h(t)", xlab="Log(Tempo)", col="red")
```



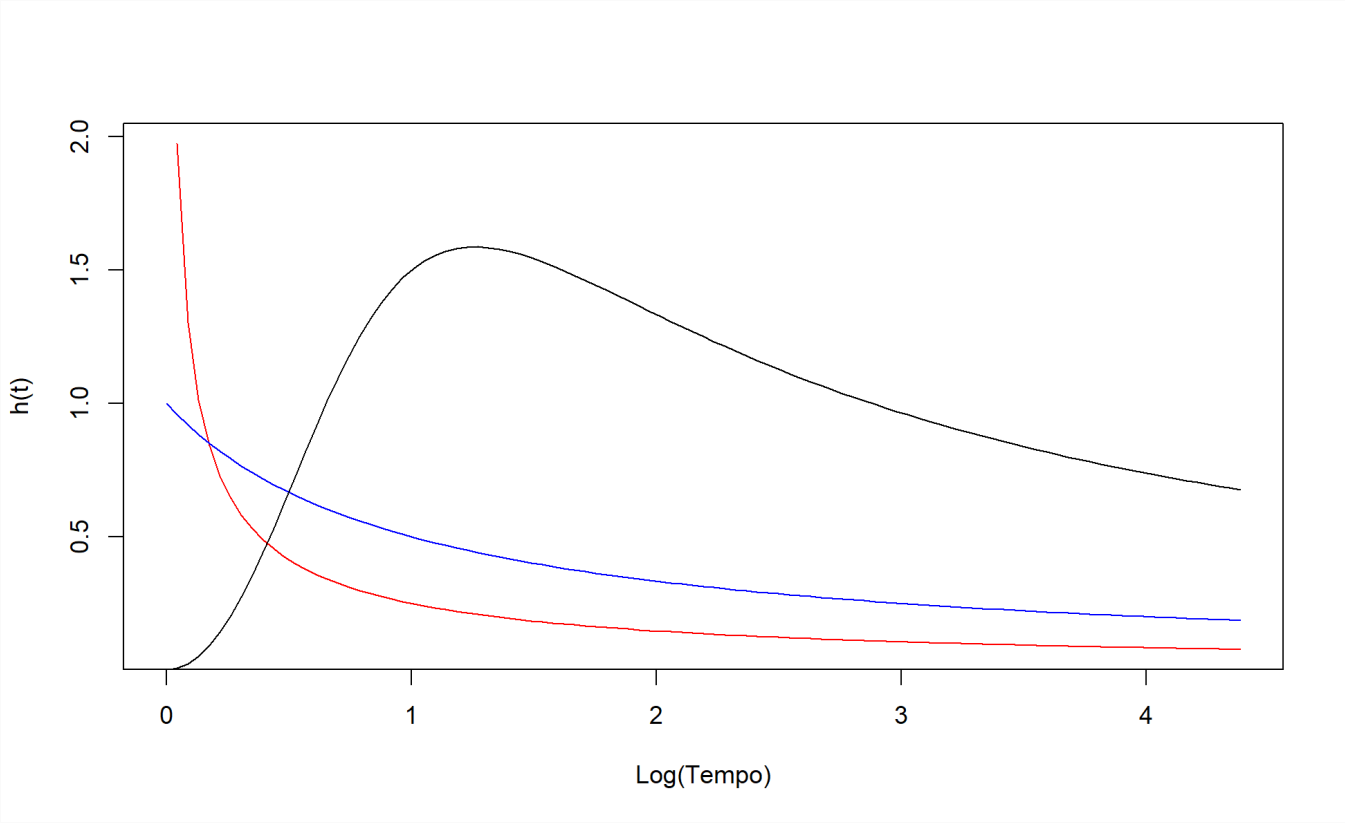
Modelos Paramétricos - Log-Logística

```
llogisHaz ← function(x, alfa, beta) {
  haz ← beta/alfa*(x/alfa)^(beta-1)/(1+(x/alfa)^beta)
}
curve(llogisHaz(x, alfa=1, beta=0.5), from=0, to=log(80)
      ylab="h(t)", xlab="Log(Tempo)", col="red")
curve(llogisHaz(x, alfa=1., beta=1), from=0, to=log(80),
      ylab="h(t)", xlab="Log(Tempo)", col="blue", add=T)
```



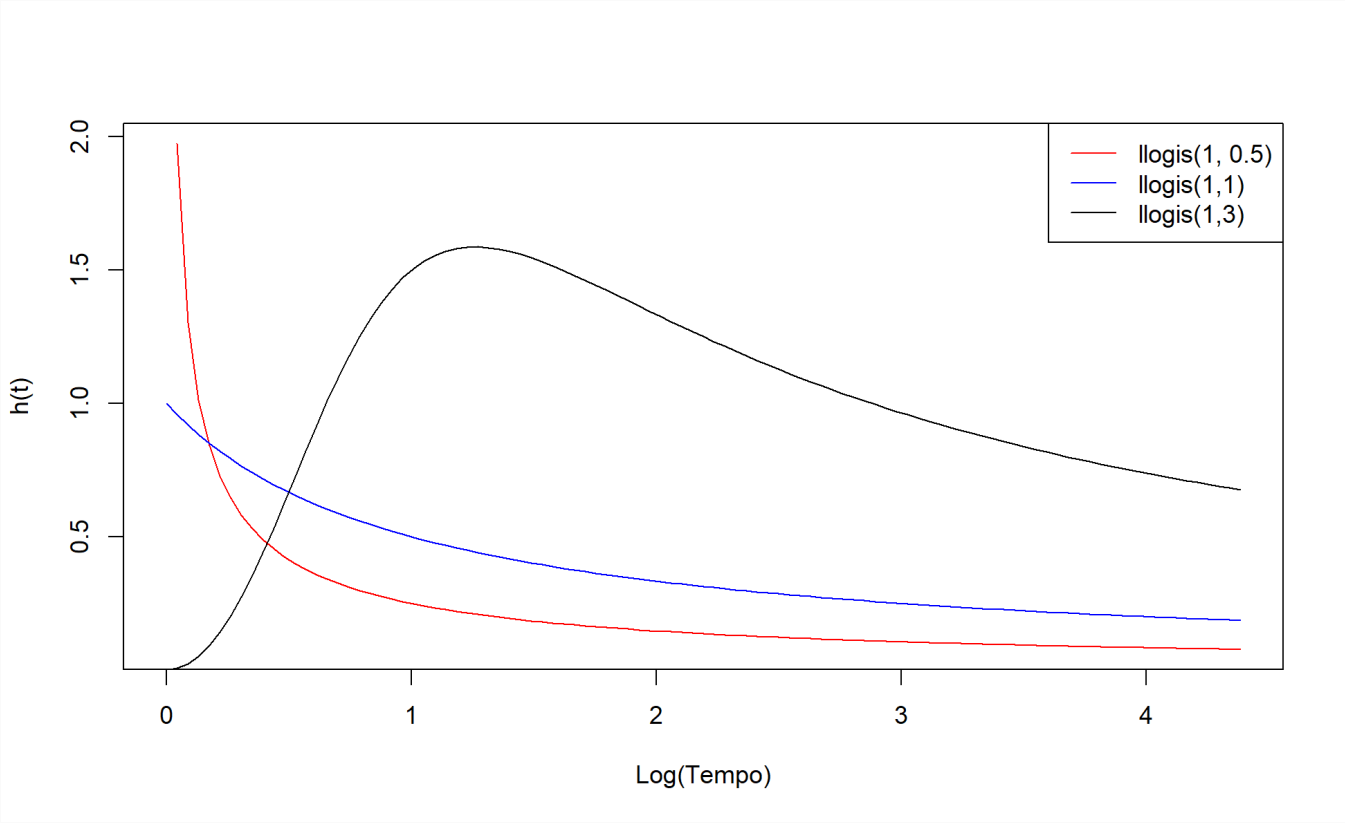
Modelos Paramétricos - Log-Logística

```
llogisHaz ← function(x, alfa, beta) {
  haz ← beta/alfa*(x/alfa)^(beta-1)/(1+(x/alfa)^beta)
}
curve(llogisHaz(x, alfa=1, beta=0.5), from=0, to=log(80)
      ylab="h(t)", xlab="Log(Tempo)", col="red")
curve(llogisHaz(x, alfa=1., beta=1), from=0, to=log(80),
      ylab="h(t)", xlab="Log(Tempo)", col="blue", add=T)
curve(llogisHaz(x, alfa=1., beta=3), from=0, to=log(80),
      ylab="h(t)", xlab="Log(Tempo)", col="black", add=T
```



Modelos Paramétricos - Log-Logística

```
llogisHaz ← function(x, alfa, beta) {
  haz ← beta/alfa*(x/alfa)^(beta-1)/(1+(x/alfa)^beta)
}
curve(llogisHaz(x, alfa=1, beta=0.5), from=0, to=log(80)
      ylab="h(t)", xlab="Log(Tempo)", col="red")
curve(llogisHaz(x, alfa=1., beta=1), from=0, to=log(80),
      ylab="h(t)", xlab="Log(Tempo)", col="blue", add=T)
curve(llogisHaz(x, alfa=1., beta=3), from=0, to=log(80),
      ylab="h(t)", xlab="Log(Tempo)", col="black", add=T
legend("topright", c("llogis(1, 0.5)", "llogis(1,1)",
                     "llogis(1,3)"),
       lty=1, col = c("red","blue","black"))
```

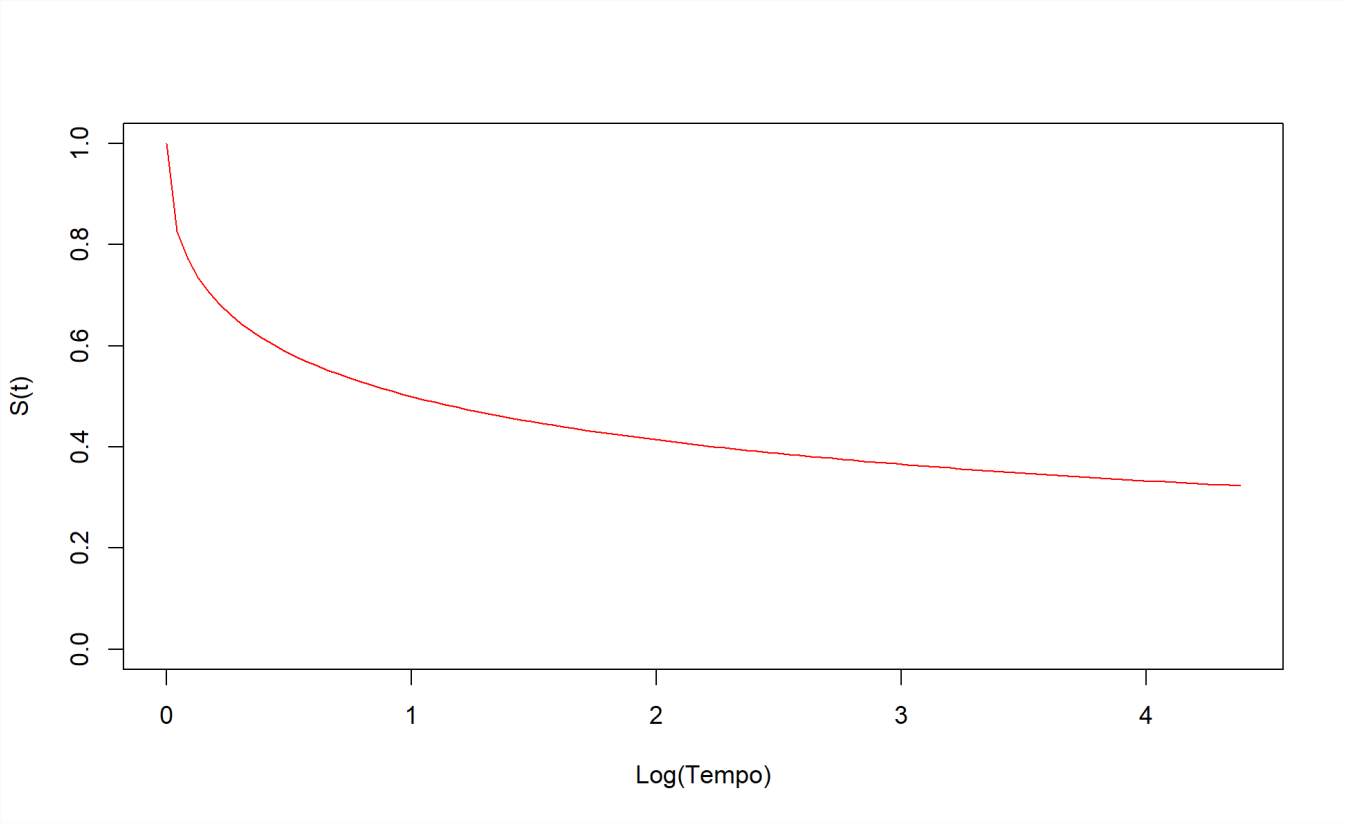


Modelos Paramétricos - Log-Logística

```
llogisSurv ← function(x, alfa, beta) {
          surv ← 1/(1+(x/alfa)^beta)
}
```

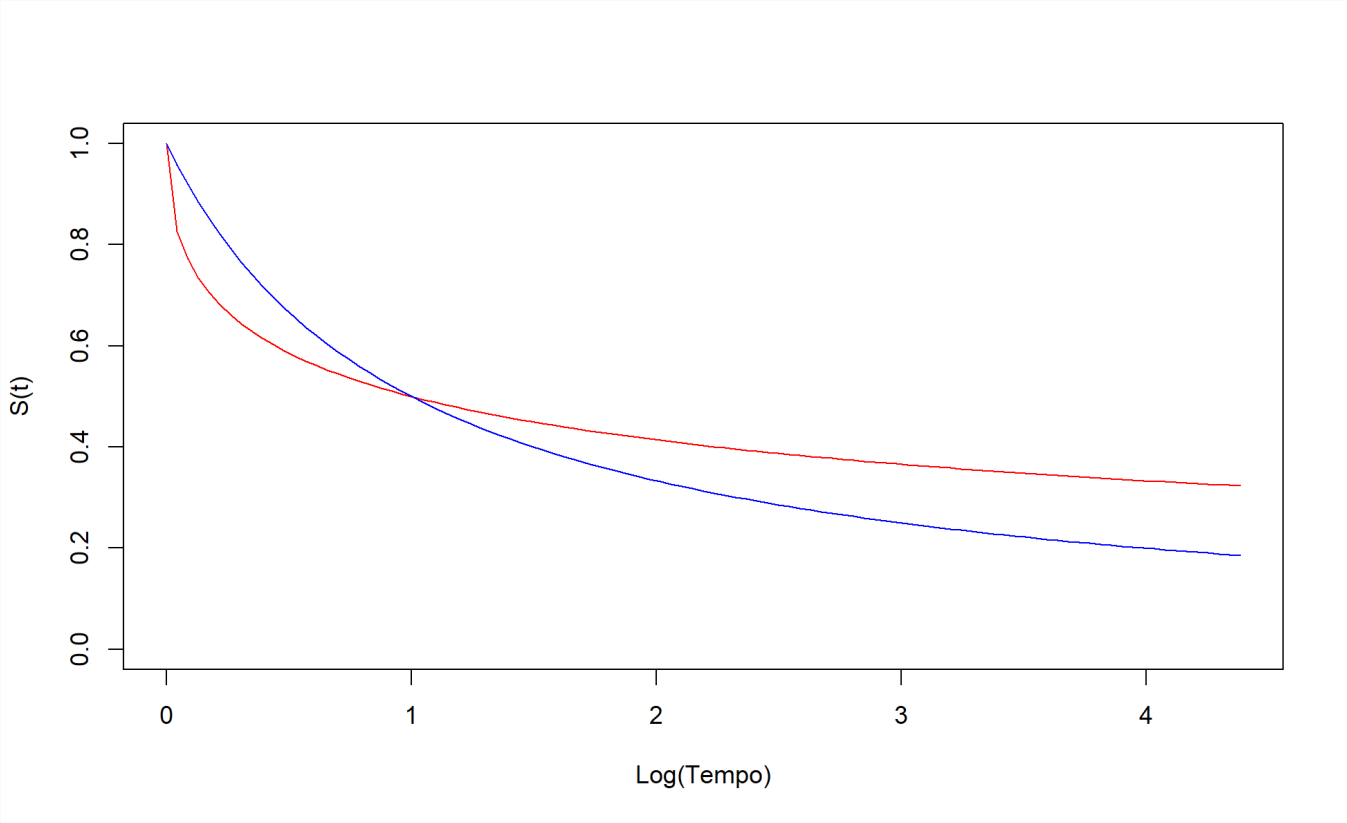
Modelos Paramétricos - Log-Logística

```
llogisSurv ← function(x, alfa, beta) {
          surv ← 1/(1+(x/alfa)^beta)
}
curve(llogisSurv(x, alfa=1, beta=0.5),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="red", ylim=c(0,1))
```



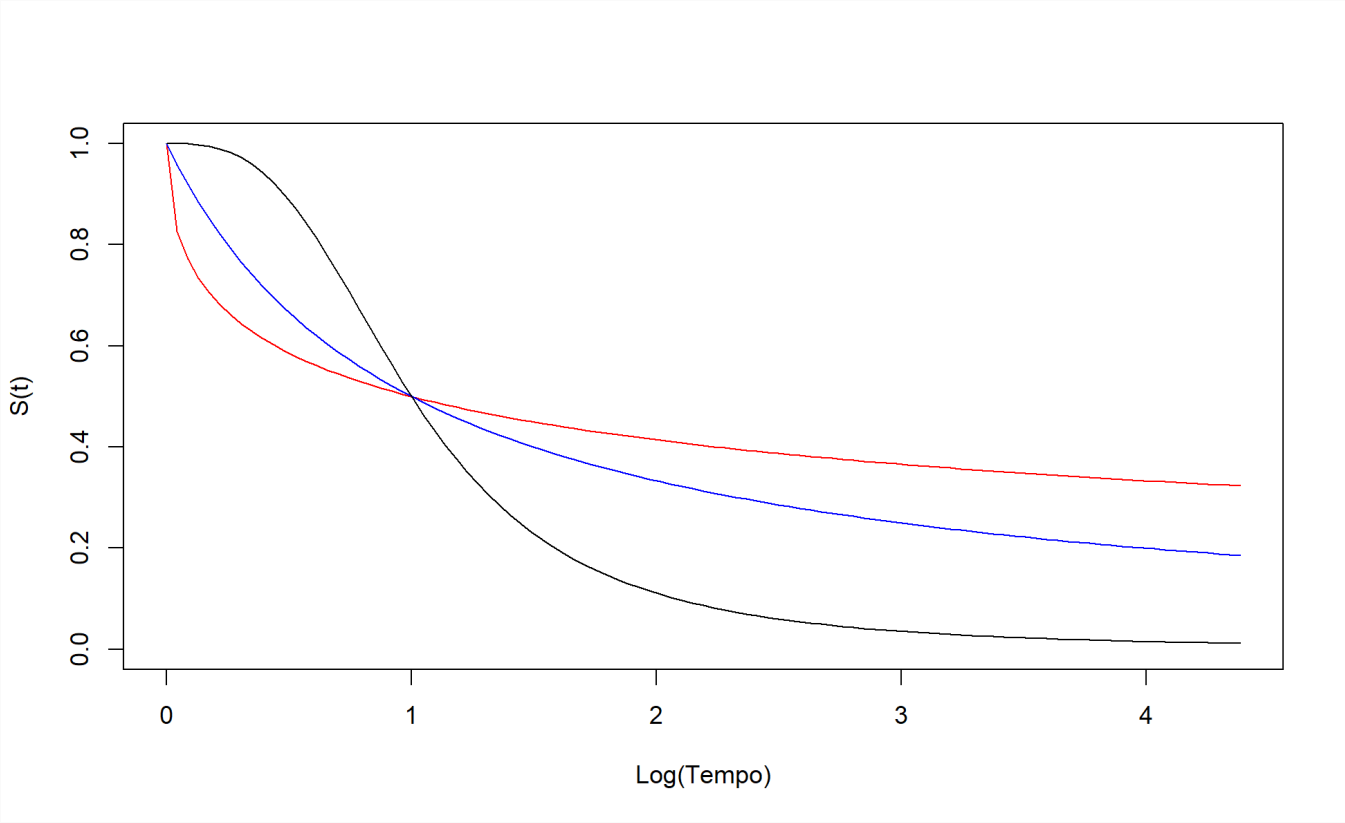
Modelos Paramétricos - Log-Logística

```
llogisSurv ← function(x, alfa, beta) {
          surv ← 1/(1+(x/alfa)^beta)
}
curve(llogisSurv(x, alfa=1, beta=0.5),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="red", ylim=c(0,1))
curve(llogisSurv(x, alfa=1, beta=1),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="blue", add=T)
```



Modelos Paramétricos - Log-Logística

```
llogisSurv ← function(x, alfa, beta) {
          surv ← 1/(1+(x/alfa)^beta)
}
curve(llogisSurv(x, alfa=1, beta=0.5),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="red", ylim=c(0,1))
curve(llogisSurv(x, alfa=1, beta=1),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="blue", add=T)
curve(llogisSurv(x, alfa=1, beta=3),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="black", add=T)
```



Modelos Paramétricos - Log-Logística

```
llogisSurv ← function(x, alfa, beta) {
          surv ← 1/(1+(x/alfa)^beta)
}
curve(llogisSurv(x, alfa=1, beta=0.5),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="red", ylim=c(0,1))
curve(llogisSurv(x, alfa=1, beta=1),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="blue", add=T)
curve(llogisSurv(x, alfa=1, beta=3),
      from=0, to=log(80),
      ylab="S(t)", xlab="Log(Tempo)",
      col="black", add=T)
legend("topright", c("llogis(1, 0.5)",
                     "llogis(1,1)",
                     "llogis(1,3)"),
       lty=1, col = c("red","blue","black"))
```