# Parametric

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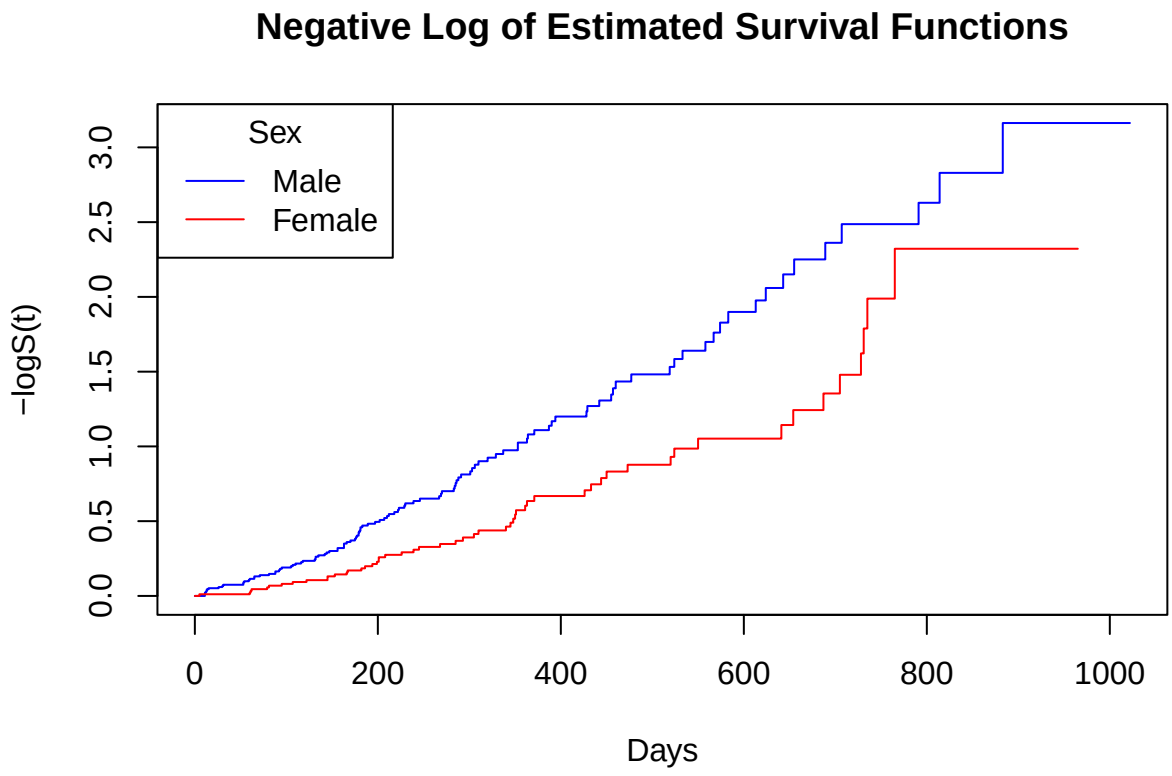
## Model Checking

**Plot** $-log\hat{S}(t)$

```
lung_fit = survfit(Surv(time, status == 2) ~ sex,
                   data = lung_df)

plot(lung_fit, col = c("blue", "red"),
     fun = "cumhaz", xlab = "Days", ylab = "-logS(t)",
     main = "Negative Log of Estimated Survival Functions")
legend("topleft", legend = c("Male", "Female"),
       title = "Sex", col = c("blue", "red"), lty = 1)
```

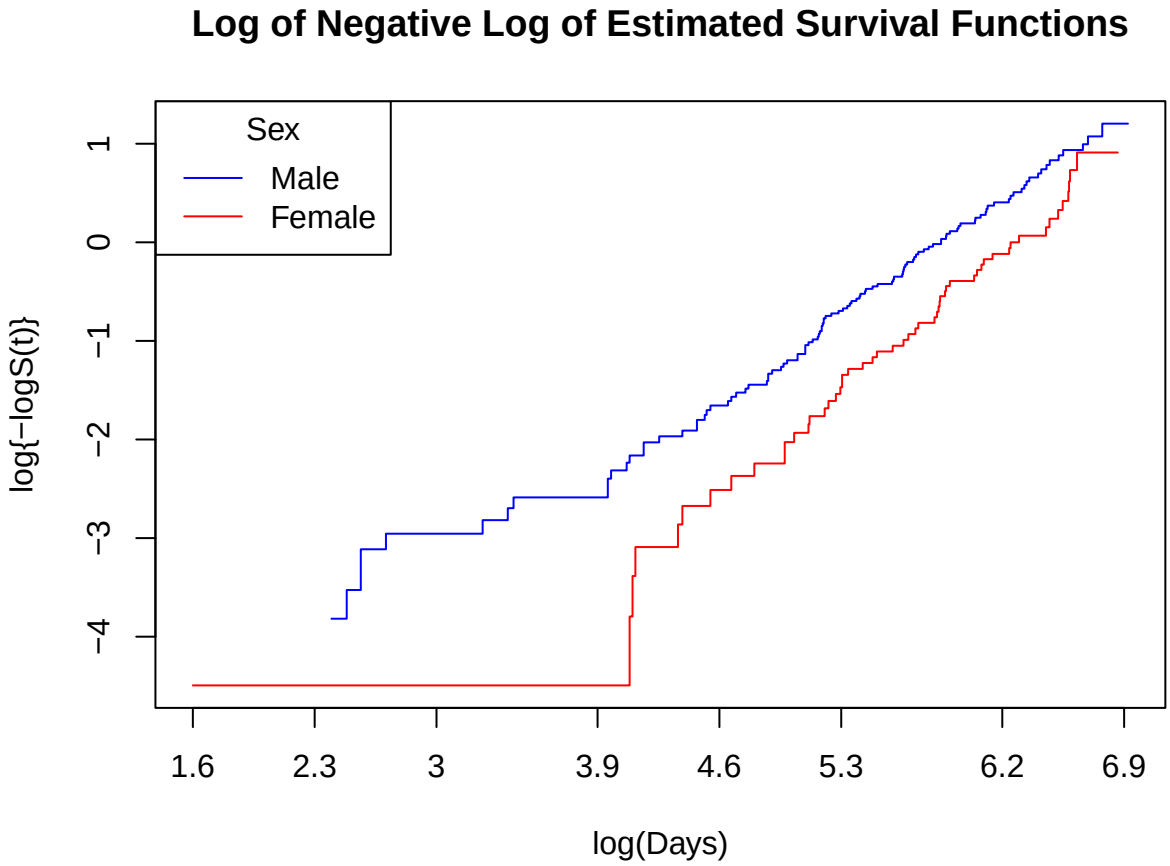



The curve for males is close to a straight line, while the curve for females is obviously non-linear, indicating a better choice of the Weibull distribution.

**Plot** $log(-logS(t))$

```
x_tick = c(5, 10, 20, 50, 100, 200, 500, 1000)
log_x = round(log(x_tick), 1)

plot(lung_fit, col = c("blue", "red"), fun = "cloglog",
     xlab = "log(Days)", ylab = "log{-logS(t)}",
     xaxt = "n", main = "Log of Negative Log of Estimated Survival Functions")
axis(1, at = x_tick, labels = log_x)
legend("topleft", legend = c("Male", "Female"),
       title = "Sex", col = c("blue", "red"), lty = 1)
```




The slope of the male curve is close to 1, while the slope of the female curve is larger than 1, also indicating a Weibull distribution.

**Fit exponential and Weilbull model**

```
#parametric survival function
fit_exp = flexsurvreg(Surv(time, status == 2) ~ sex,
                      data = lung_df, dist = "exp")
```

```r
fit_web <- flexsurvreg(Surv(time, status == 2) ~ sex,
                       data = lung_df, dist = "weibull")

#exp parameter estimation and CI
fit_exp
```

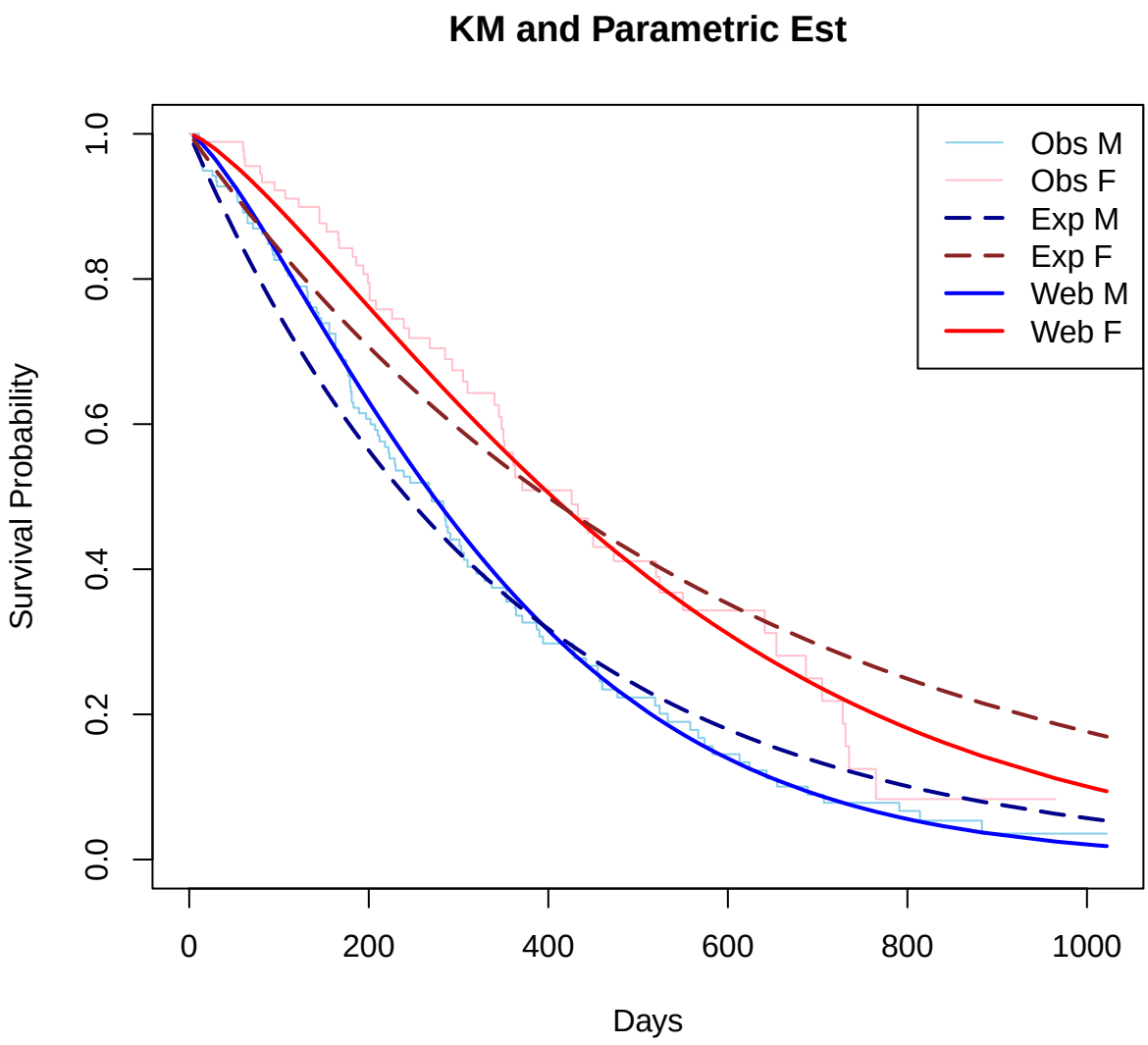
```
## Call:
## flexsurvreg(formula = Surv(time, status == 2) ~ sex, data = lung_df,
##     dist = "exp")
##
## Estimates:
##       data mean  est        L95%       U95%       se         exp(est)
## rate         NA   0.002865   0.002381   0.003448   0.000271         NA
## sex2   0.394737  -0.500399  -0.827169  -0.173628   0.166723   0.606289
##       L95%       U95%
## rate         NA         NA
## sex2   0.437285   0.840609
##
## N = 228,  Events: 165,  Censored: 63
## Total time at risk: 69593
## Log-likelihood = -1157.6, df = 2
## AIC = 2319.199
```

```r
#Weibull parameter estimation and CI
fit_web
```

```
## Call:
## flexsurvreg(formula = Surv(time, status == 2) ~ sex, data = lung_df,
##     dist = "weibull")
##
## Estimates:
##        data mean  est      L95%     U95%     se       exp(est)  L95%
## shape        NA      1.324    1.173    1.495    0.082       NA        NA
## scale        NA    359.301  312.034  413.729   25.857       NA        NA
## sex2      0.395      0.396    0.145    0.646    0.128    1.485     1.156
##        U95%
## shape        NA
## scale        NA
## sex2      1.907
##
## N = 228,  Events: 165,  Censored: 63
## Total time at risk: 69593
## Log-likelihood = -1148.652, df = 3
## AIC = 2303.303
```

```r
#plot km, exp fitted and web fitted
plot(fit_web,
     lwd = 2, lwd.obs = 1,
     col = c("blue", "red"), col.obs = c("skyblue", "pink"),
     xlab = "Days", ylab = "Survival Probability",
     main = "KM and Parametric Est")
plot(fit_exp, add = TRUE,
```

```
     lwd = 2, col = c("blue4", "brown4"), lty = "longdash")
legend("topright", legend = c("Obs M", "Obs F", "Exp M", "Exp F", "Web M", "Web F"),
       col = c("skyblue", "pink", "blue4", "brown4", "blue", "red"),
       lty = c("solid", "solid", "longdash", "longdash", "solid", "solid"),
       lwd = c(1,1,2,2,2,2))
```




From the plot we can see that fitting a Weibull distribution is actually more precise than an exponential distribution.