Assignment 3

Zhiwen Tan

3/14/2022

Question 1

a) To get the 95% confidence interval for median survival time, that is find $t_{0.5}$. We first need to fit a Weibull model for the data at stress level $750N/mm^2$, the result below is the model fit result. Then we have $\hat{\sigma}$, $\hat{\mu}$ and estimate $\hat{Var}$.Then let $Y = logT$, and we can calculate $y_{0.5}$. After this step, we can calculate the $Var(\hat{y_{0.5}})$. Now, we can use 95% CI for $y_{0.5}$. Finally, we can use $t_{0.5} = exp(y_{0.5})$ to get 95% confidence interval for median(t_0.5) is [5142.356, 14100.130].

```
##
## Call:
## survreg(formula = Surv(x, delta) ~ 1)
##              Value Std. Error     z      p
## (Intercept)  8.798      0.234 37.55 <2e-16
## Log(scale)  -0.376      0.267 -1.41   0.16
##
## Scale= 0.686
##
## Weibull distribution
## Loglik(model)= -86.8   Loglik(intercept only)= -86.8
## Number of Newton-Raphson Iterations: 6
## n= 10
```

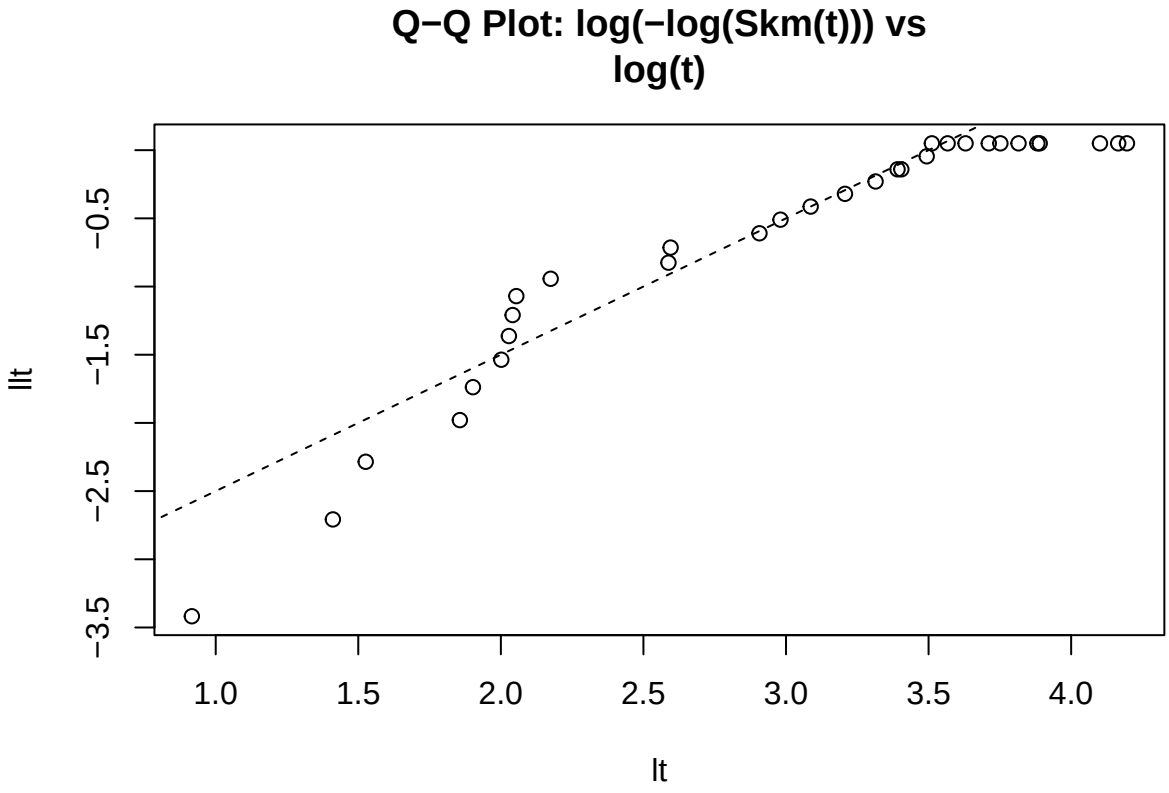
```
## (Intercept) (Intercept)
##    5142.356   14100.130
```

b) To get the confidence interval for the probability that the type of spring survives over 6000 thousand cycles at the stress level $750N = mm^2$. that is find the $S(6000)$. The first step is to find the CI for $log[-log(S(t))]$, this is equal to $(log(t)-\mu)e^{-\phi}$. Then we can find $var((log(t)-\mu)e^{-\phi})$ using δ-method. Now, we have the 95% CI for $log[-log(S(6000))]$, Then we can calculate CIl and CIu by using $exp(-exp(\hat{\psi_u}))$ and $exp(-exp(\hat{\psi_l}))$. Finally, we can get the result 95% CI is [0.108, 0.550]

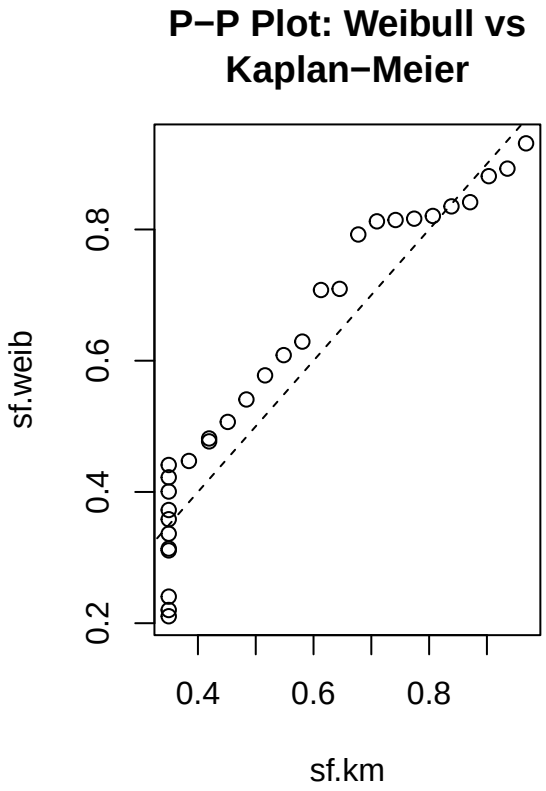
```
## [1] 0.1078917 0.5496670
```

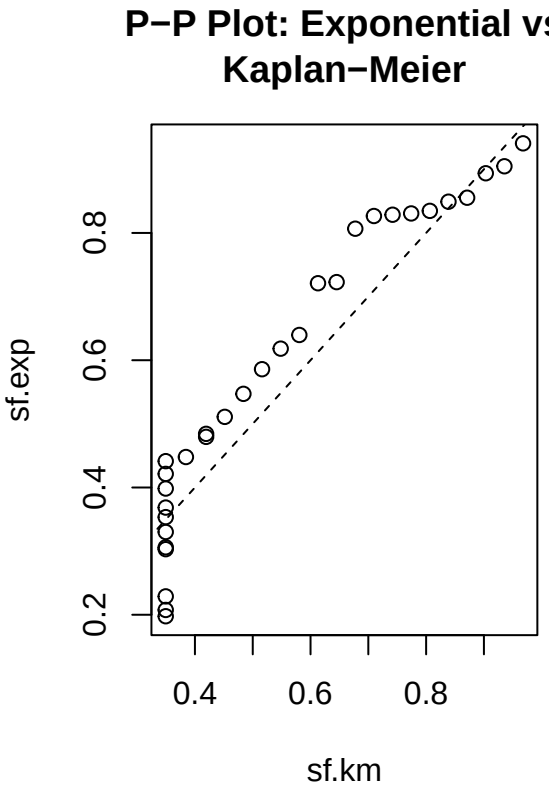
Question 2

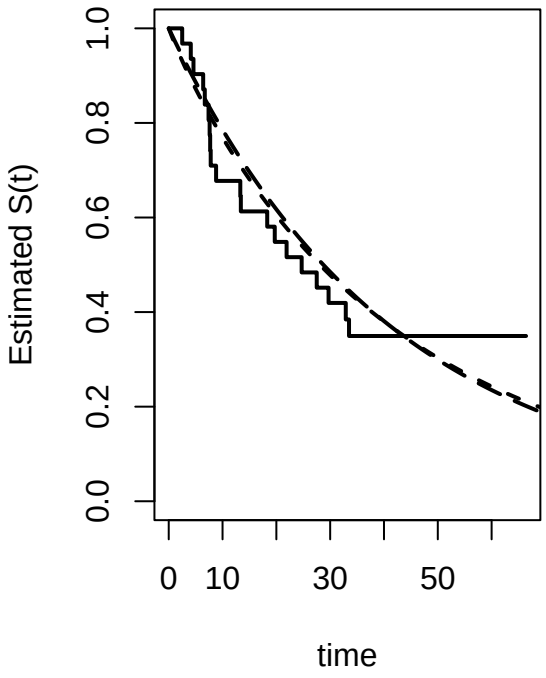
a) If weibull distribution fits well, then the Q-Q plot for $log(-log(Skm(t)))vslog(t)$ should be show an approximatly linear relationship.However, form the plot below, we can see the Q-Q plot is not very linear, this means weibull distribution may not fit the data very well.



b)


P−P Plot: Weibull vs Kaplan−Meier
sf.weib
sf.km
0.2
0.4
0.6
0.8
0.4
0.6
0.8


P−P Plot: Exponential vs Kaplan−Meier
sf.exp
sf.km
0.2
0.4
0.6
0.8
0.4
0.6
0.8


Advanced non−Hodgkin’s Lympho
Estimated S(t)
0.0
0.2
0.4
0.6
0.8
1.0
0
10
30
50
time