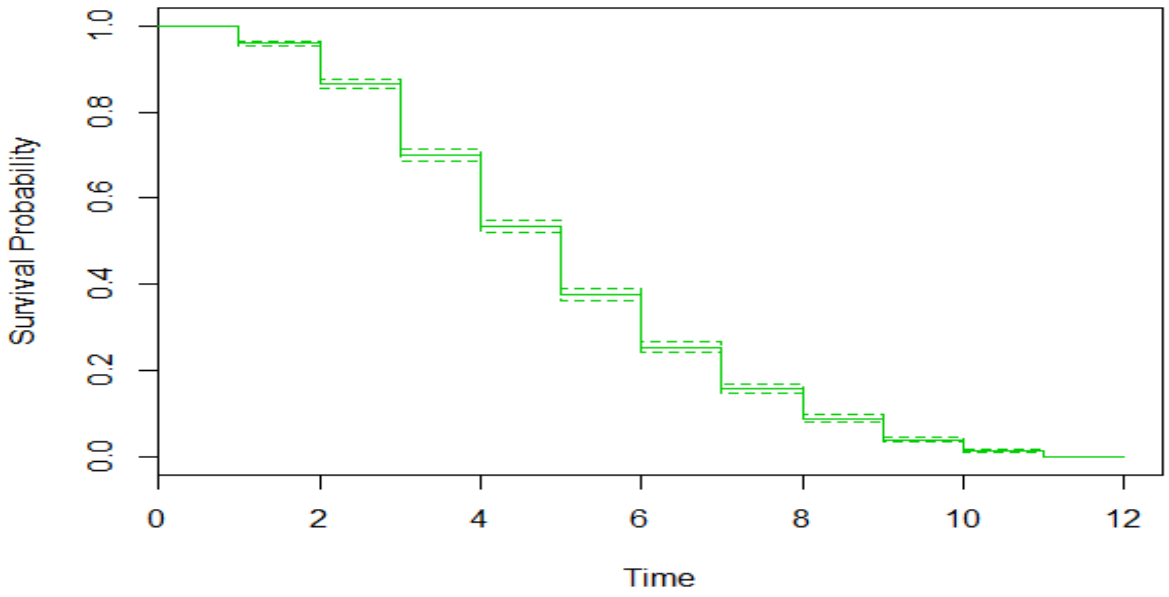
```
> mydatatry4<- read.csv("C:/Users/Nirbhay Pherwani/Desktop/Nirbhay_Final/sample2.csv")
>
> attach(mydatatry4)

>
> # Define variables
>
> time <- Spell
>
> event <- event
>
> z <- cbind(Failure.Code,Model.Family.Desc,Part.Desc)
>
> group <- Part.Desc
>
> # Descriptive statistics
>
> summary(time)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
  1.000   3.000   5.000   4.996   7.000  12.000
>
> summary(event)
   Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
      1       1       1       1       1       1
>
> summary(z)
  Failure.Code    Model.Family.Desc   Part.Desc
 Min.   : 1.000   Min.   :1.000     Min.   :1.000
 1st Qu.: 3.000   1st Qu.:5.000     1st Qu.:4.000
 Median : 3.000   Median :5.000     Median :4.000
 Mean   : 3.348   Mean   :4.846     Mean   :4.572
 3rd Qu.: 3.000   3rd Qu.:5.000     3rd Qu.:6.000
 Max.   :12.000   Max.   :5.000     Max.   :6.000
>
> summary(group)
          VACUUM MODULATOR   Vacuum Modulator-Padmini VACUUM MODULATOR - PADMINI
                       352                          5                        192
VACUUM MODULATOR (EGR) R&R VACUUM MODULATOR (VGT) R&R       VACUUM MODULATOR EGR
                      1932                        329                       1777
>
> library(survival)
>
>
> # Kaplan-Meier non-parametric analysis
>
> kmsurvival <- survfit(Surv(time,event) ~ 1 , data=mydatatry4)
>
> summary(kmsurvival)
Call: survfit(formula = Surv(time, event) ~ 1, data = mydatatry4)

 time n.risk n.event survival  std.err lower 95% CI upper 95% CI
    1   4587     188  0.95901 0.002927      0.95329      0.96477
    2   4399     434  0.86440 0.005055      0.85455      0.87436
    3   3965     754  0.70002 0.006766      0.68689      0.71341
    4   3211     759  0.53455 0.007365      0.52031      0.54919
    5   2452     725  0.37650 0.007154      0.36274      0.39078
    6   1727     558  0.25485 0.006434      0.24255      0.26778
    7   1169     437  0.15958 0.005407      0.14933      0.17054
    8    732     320  0.08982 0.004222      0.08191      0.09849
    9    412     229  0.03990 0.002890      0.03462      0.04598
   10    183     115  0.01482 0.001784      0.01171      0.01877
   11     68      58  0.00218 0.000689      0.00117      0.00405
   12     10      10  0.00000      NaN           NA           NA
```

```
>
> plot(kmsurvival, xlab="Time", ylab="Survival Probability" ,col=3)
>
> # End of Kaplan-Meier non-parametric analysis
>
>
> # Kaplan-Meier non-parametric analysis by group
>
> kmsurvival1 <- survfit(Surv(time, event) ~ group , data=mydatatry4)
>
> summary(kmsurvival1)
Call: survfit(formula = Surv(time, event) ~ group, data = mydatatry4)

                group=VACUUM MODULATOR
 time n.risk n.event survival std.err lower 95% CI upper 95% CI
    1    352      23  0.93466 0.01317      0.90920       0.9608
    2    329      53  0.78409 0.02193      0.74226       0.8283
    3    276      71  0.58239 0.02629      0.53308       0.6363
    4    205      65  0.39773 0.02609      0.34975       0.4523
    5    140      48  0.26136 0.02342      0.21927       0.3115
    6     92      33  0.16761 0.01991      0.13280       0.2116
    7     59      25  0.09659 0.01574      0.07018       0.1329
    8     34      16  0.05114 0.01174      0.03261       0.0802
    9     18      10  0.02273 0.00794      0.01146       0.0451
   10      8       6  0.00568 0.00401      0.00143       0.0226
   11      2       2  0.00000     NaN           NA           NA

                group=Vacuum Modulator-Padmini
 time n.risk n.event survival std.err lower 95% CI upper 95% CI
    3      5       1      0.8   0.179       0.5161            1
    4      4       2      0.4   0.219       0.1367            1
    7      2       1      0.2   0.179       0.0346            1
    8      1       1      0.0     NaN           NA           NA

                group=VACUUM MODULATOR - PADMINI
 time n.risk n.event survival std.err lower 95% CI upper 95% CI
    1    192       6  0.96875 0.01256     0.944449       0.9937
    2    186      14  0.89583 0.02205     0.853650       0.9401
    3    172      36  0.70833 0.03280     0.646872       0.7756
    4    136      46  0.46875 0.03601     0.403222       0.5449
    5     90      40  0.26042 0.03167     0.205185       0.3305
    6     50      20  0.15625 0.02620     0.112478       0.2171
    7     30      13  0.08854 0.02050     0.056241       0.1394
    8     17       9  0.04167 0.01442     0.021144       0.0821
    9      8       5  0.01562 0.00895     0.005084       0.0480
   10      3       2  0.00521 0.00519     0.000737       0.0368
   11      1       1  0.00000     NaN           NA           NA

                group=VACUUM MODULATOR (EGR) R&R
 time n.risk n.event survival std.err lower 95% CI upper 95% CI
    1   1932      80  0.95859 0.00453     0.949749      0.96752
    2   1852     178  0.86646 0.00774     0.851424      0.88176
    3   1674     315  0.70342 0.01039     0.683341      0.72408
    4   1359     317  0.53934 0.01134     0.517563      0.56203
    5   1042     302  0.38302 0.01106     0.361948      0.40532
    6    740     241  0.25828 0.00996     0.239484      0.27855
    7    499     188  0.16097 0.00836     0.145392      0.17822
    8    311     138  0.08954 0.00650     0.077676      0.10323
    9    173      97  0.03934 0.00442     0.031558      0.04904
   10     76      50  0.01346 0.00262     0.009187      0.01971
   11     26      22  0.00207 0.00103     0.000778      0.00551
   12      4       4  0.00000     NaN           NA           NA
```

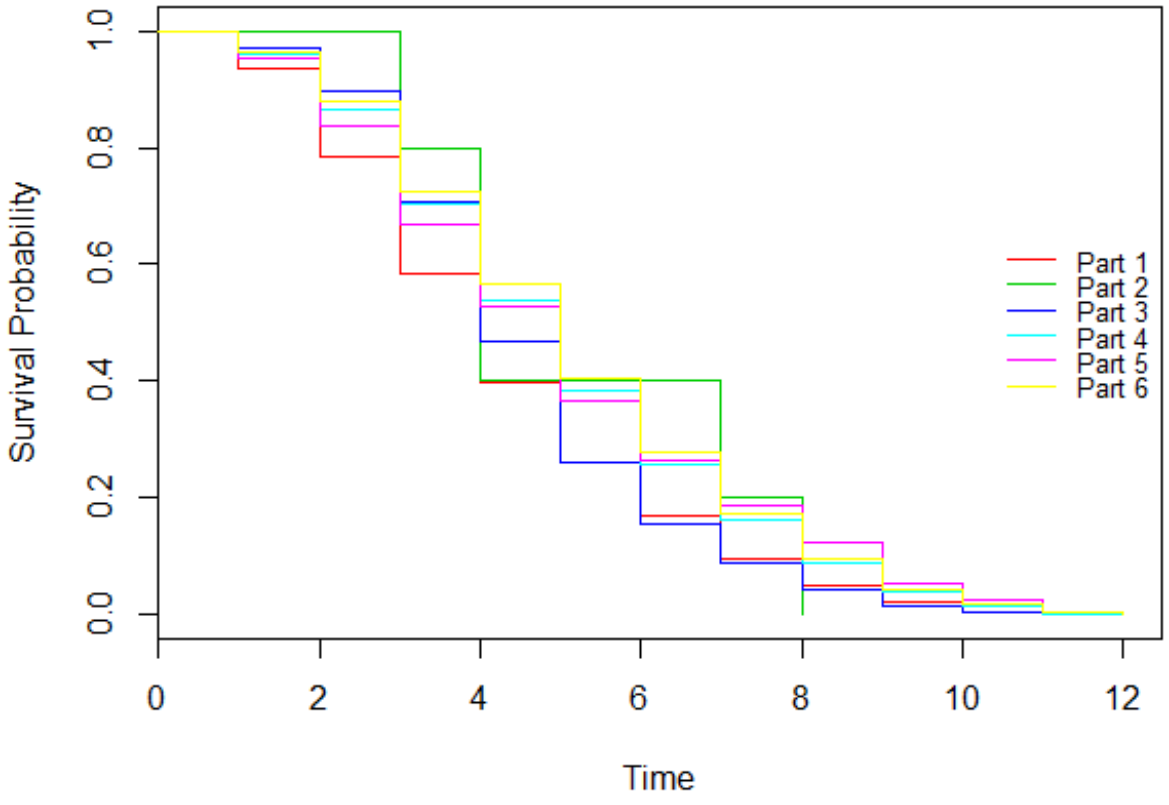
```
                group=VACUUM MODULATOR (VGT) R&R
 time n.risk n.event survival std.err lower 95% CI upper 95% CI
    1    329      16  0.95137 0.01186     0.928407       0.9749
    2    313      38  0.83587 0.02042     0.796786       0.8769
    3    275      55  0.66869 0.02595     0.619719       0.7215
    4    220      46  0.52888 0.02752     0.477597       0.5857
    5    174      53  0.36778 0.02658     0.319199       0.4238
    6    121      34  0.26444 0.02431     0.220829       0.3167
    7     87      25  0.18845 0.02156     0.150595       0.2358
    8     62      21  0.12462 0.01821     0.093586       0.1659
    9     41      23  0.05471 0.01254     0.034915       0.0857
   10     18      10  0.02432 0.00849     0.012264       0.0482
   11      8       7  0.00304 0.00303     0.000429       0.0215
   12      1       1  0.00000     NaN           NA           NA

                group=VACUUM MODULATOR EGR
 time n.risk n.event survival std.err lower 95% CI upper 95% CI
    1   1777      63  0.96455 0.00439      0.95599      0.97318
    2   1714     151  0.87957 0.00772      0.86457      0.89484
    3   1563     276  0.72425 0.01060      0.70377      0.74533
    4   1287     283  0.56500 0.01176      0.54241      0.58852
    5   1004     282  0.40630 0.01165      0.38410      0.42979
    6    722     230  0.27687 0.01061      0.25683      0.29848
    7    492     185  0.17276 0.00897      0.15605      0.19127
    8    307     135  0.09679 0.00701      0.08398      0.11156
    9    172      94  0.04389 0.00486      0.03533      0.05453
   10     78      47  0.01745 0.00311      0.01231      0.02473
   11     31      26  0.00281 0.00126      0.00117      0.00675
   12      5       5  0.00000     NaN           NA           NA

>
> plot(kmsurvival1, xlab="Time", ylab="Survival Probability",col=2:7)
>
> legend('right',paste('Part',1:6), col=2:7, lty=1, cex=.8, bty='n')
>
>
> # End of Kaplan-Meier non-parametric analysis by group
>
>
> # Nelson-Aalen non-parametric analysis
>
> nasurvival <- survfit(coxph(Surv(time,event)~1 , data=mydatatry4), type="aalen" )
>
> summary(nasurvival)
Call: survfit(formula = coxph(Surv(time, event) ~ 1, data = mydatatry4),
    type = "aalen")

 time n.risk n.event survival std.err lower 95% CI upper 95% CI
    1   4587     188  0.95984 0.00287      0.95424       0.9655
    2   4399     434  0.86967 0.00487      0.86017       0.8793
    3   3965     754  0.71906 0.00640      0.70662       0.7317
    4   3211     759  0.56769 0.00702      0.55409       0.5816
    5   2452     725  0.42238 0.00699      0.40890       0.4363
    6   1727     558  0.30576 0.00656      0.29316       0.3189
    7   1169     437  0.21039 0.00588      0.19918       0.2222
    8    732     320  0.13589 0.00504      0.12635       0.1461
    9    412     229  0.07794 0.00407      0.07036       0.0863
   10    183     115  0.04158 0.00326      0.03565       0.0485
   11     68      58  0.01772 0.00242      0.01355       0.0232
   12     10      10  0.00652 0.00225      0.00332       0.0128
>
> plot(nasurvival, xlab="Time", ylab="Survival Probability", col=4)
>
```

```
> # End of Nelson-Aalen non-parametric analysis
>
>
> # Weibull Survival Analysis
> survreg(Surv(time,event)~ group, dist='weibull' , data=mydatatry4) -> out.weib
>
> summary(out.weib)

Call:
survreg(formula = Surv(time, event) ~ group, data = mydatatry4,
    dist = "weibull")
                                Value Std. Error       z        p
(Intercept)                    1.6038     0.0234  68.647 0.00e+00
groupVacuum Modulator-Padmini  0.1275     0.1962   0.650 5.16e-01
groupVACUUM MODULATOR - PADMINI  0.0251     0.0391   0.641 5.22e-01
groupVACUUM MODULATOR (EGR) R&R  0.1309     0.0253   5.183 2.18e-07
groupVACUUM MODULATOR (VGT) R&R  0.1498     0.0334   4.485 7.29e-06
groupVACUUM MODULATOR EGR      0.1531     0.0254   6.023 1.71e-09
Log(scale)                    -0.8308     0.0115 -72.143 0.00e+00

Scale= 0.436

Weibull distribution
Loglik(model)= -10190.2   Loglik(intercept only)= -10212.3
    Chisq= 44.31 on 5 degrees of freedom, p= 2e-08
Number of Newton-Raphson Iterations: 6
n= 4587

>
> curve(pweibull(x, scale=exp(coef(out.weib)[1]),shape=1/out.weib$scale,lower.tail = FALSE), from=0,
to=12, ylab="Survival ",xlab="months",axes=F)
> axis(1,cex.axis=.8)
> axis(2,cex.axis=.8)
> box()
> curve(pweibull(x, scale=exp(coef(out.weib)[1]+ coef(out.weib)[2]), shape=1/out.weib$scale,lower.tail
= FALSE), from=0, to=12,add=T,col=2)
> curve(pweibull(x, scale=exp(coef(out.weib)[1]+coef(out.weib)[3]), shape=1/out.weib$scale, lower.tail
= FALSE), from=0, to=12, add=T,col=3)
> curve(pweibull(x, scale=exp(coef(out.weib)[1]+coef(out.weib)[4]), shape=1/out.weib$scale, lower.tail
= FALSE), from=0, to=12, add=T,col=4)
> curve(pweibull(x, scale=exp(coef(out.weib)[1]+coef(out.weib)[5]), shape=1/out.weib$scale, lower.tail
= FALSE), from=0, to=12, add=T,col=5)
> curve(pweibull(x, scale=exp(coef(out.weib)[1]+coef(out.weib)[6]), shape=1/out.weib$scale, lower.tail
= FALSE), from=0, to=12, add=T,col=6)
> legend('right',paste('Part',1:6), col=1:6, lty=1, cex=.8, bty='n')
>
> #End of Weibull Survival Analysis
>
> #Weibull Failure Analysis
>
> curve(pweibull(x, scale=exp(coef(out.weib)[1]),shape=1/out.weib$scale), from=0, to=12, ylab="Failure
",xlab="months",axes=F)
> axis(1,cex.axis=.8)
> axis(2,cex.axis=.8)
> box()
> curve(pweibull(x, scale=exp(coef(out.weib)[1]+ coef(out.weib)[2]), shape=1/out.weib$scale), from=0,
to=12,add=T,col=2)
> curve(pweibull(x, scale=exp(coef(out.weib)[1]+coef(out.weib)[3]), shape=1/out.weib$scale), from=0,
to=12, add=T,col=3)
> curve(pweibull(x, scale=exp(coef(out.weib)[1]+coef(out.weib)[4]), shape=1/out.weib$scale), from=0,
to=12, add=T,col=4)
> curve(pweibull(x, scale=exp(coef(out.weib)[1]+coef(out.weib)[5]), shape=1/out.weib$scale), from=0,
to=12, add=T,col=5)
```

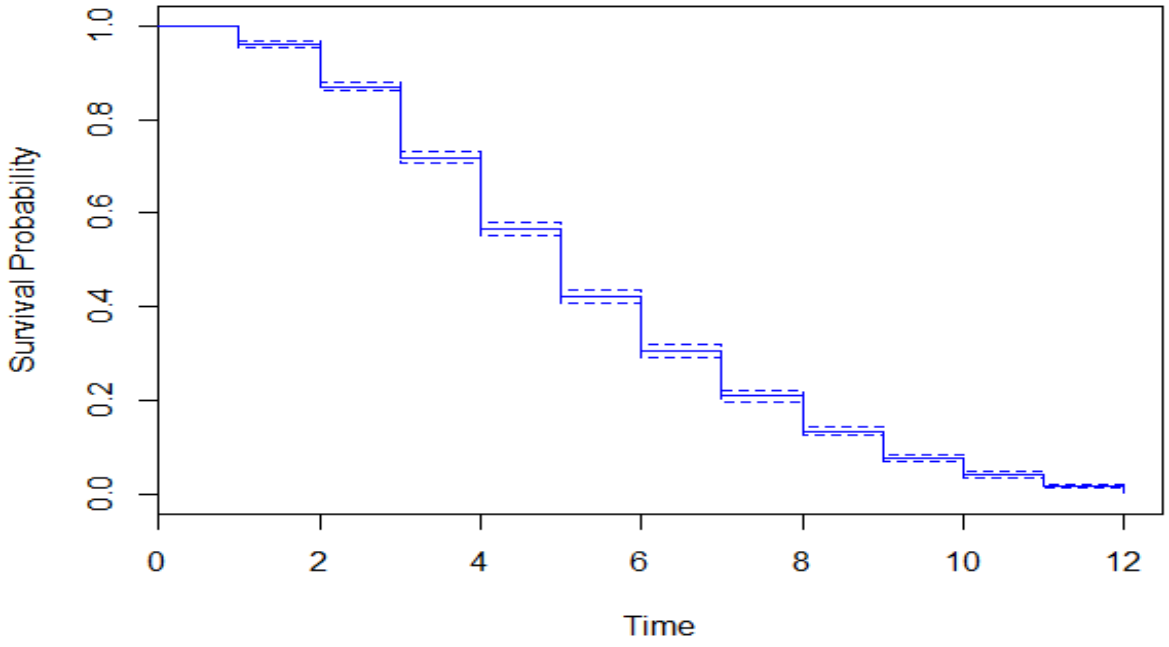
```
> curve(pweibull(x, scale=exp(coef(out.weib)[1]+coef(out.weib)[6]), shape=1/out.weib$scale), from=0,
to=12, add=T,col=6)
>
> legend('right',paste('Part',1:6), col=1:6, lty=1, cex=.8, bty='n')
>
> #End of Weibull Failure Analysis
>
>
> #Weibull Density
>
> curve(dweibull(x, scale=exp(coef(out.weib)[1]),shape=1/out.weib$scale), from=0, to=16, ylab="Density
",xlab="months",axes=F)
> axis(1,cex.axis=.8)
> axis(2,cex.axis=.8)
> box()
> curve(dweibull(x, scale=exp(coef(out.weib)[1]+ coef(out.weib)[2]), shape=1/out.weib$scale), from=0,
to=16,add=T,col=2)
> curve(dweibull(x, scale=exp(coef(out.weib)[1]+coef(out.weib)[3]), shape=1/out.weib$scale), from=0,
to=16, add=T,col=3)
> curve(dweibull(x, scale=exp(coef(out.weib)[1]+coef(out.weib)[4]), shape=1/out.weib$scale), from=0,
to=16, add=T,col=4)
> curve(dweibull(x, scale=exp(coef(out.weib)[1]+coef(out.weib)[5]), shape=1/out.weib$scale), from=0,
to=16, add=T,col=5)
> curve(dweibull(x, scale=exp(coef(out.weib)[1]+coef(out.weib)[6]), shape=1/out.weib$scale), from=0,
to=16, add=T,col=6)
>
> legend('right',paste('Part',1:6), col=1:6, lty=1, cex=.8, bty='n')
>
> #End of Weibull Density
>
```



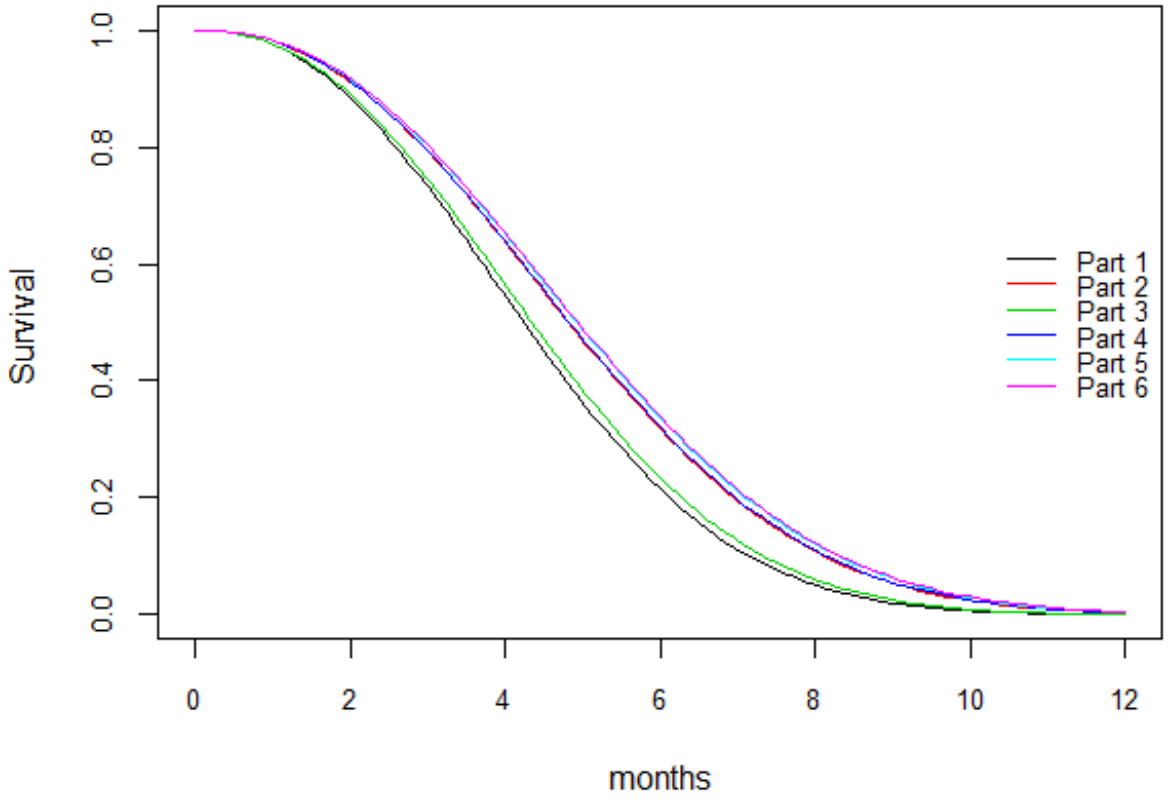
KAPLAN MEIER NON PARAMETRIC ANALYSIS



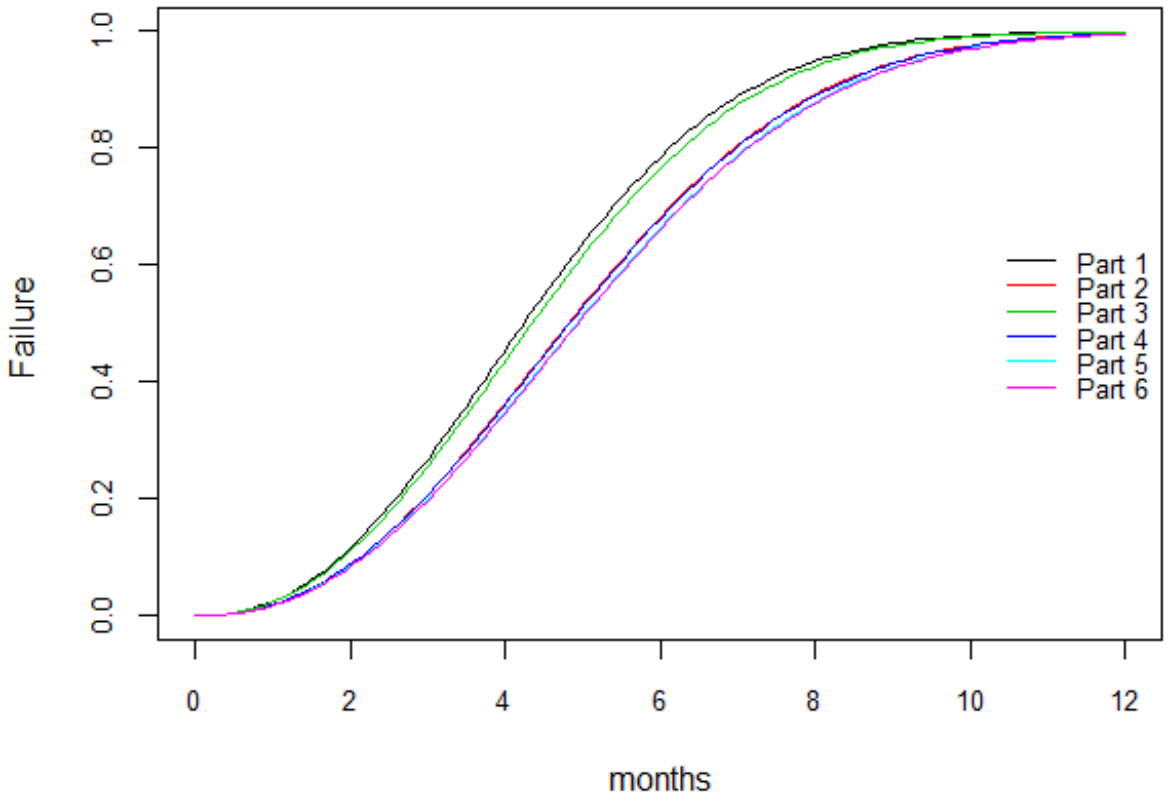
KAPLAN MEIER NON PARAMETRIC ANALYSIS BY GROUP



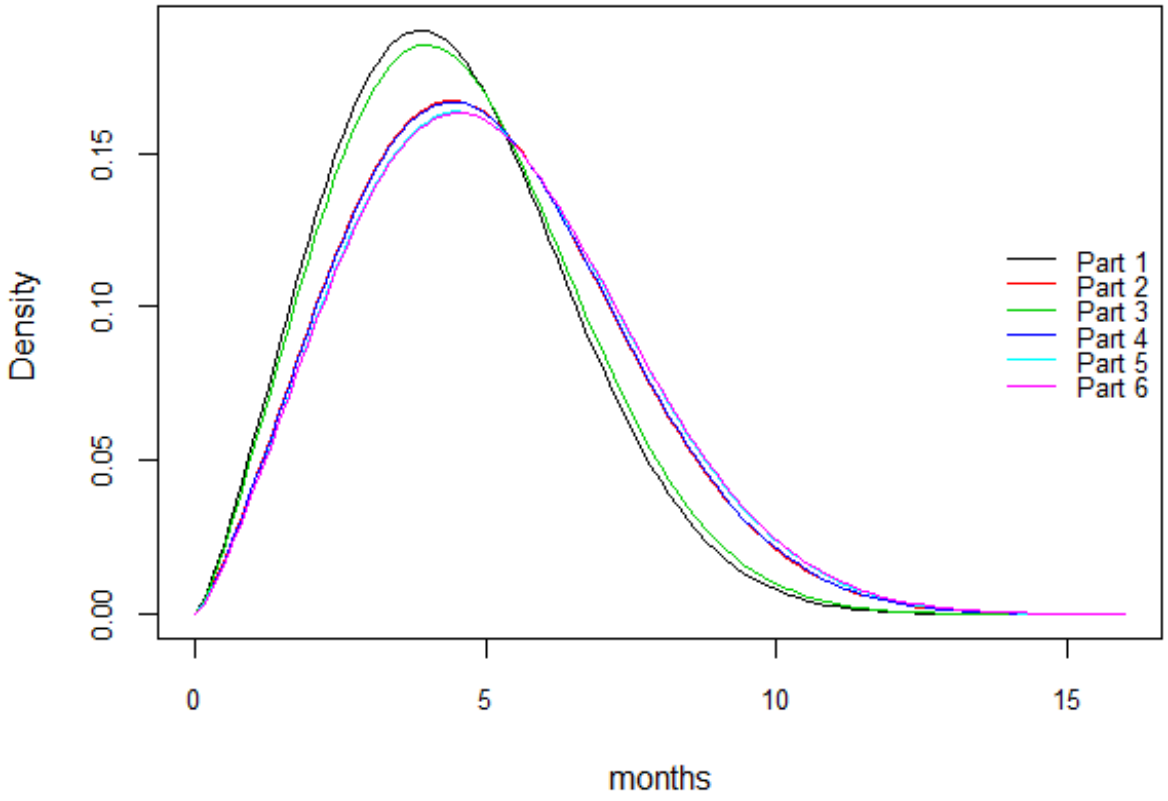
NELSON-AALEN NON PARAMETRIC ANALYSIS



WEIBULL SURVIVAL ANALYSIS



WEIBULL FAILURE ANALYSIS



WEIBULL DENSITY