

```

>
> # Define variables
>
> time <- Spell
>
> event <- event
>
> z <- cbind(Failure.Code,Model.Family.Desc)
>
> group <- Model.Family.Desc
>
> # Descriptive statistics
>
> summary(time)
  Min. 1st Qu.  Median    Mean 3rd Qu.    Max.
 1.000  3.000   5.000   4.802  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
Min.   : 1.00  Min.   :1.000
1st Qu.:10.00  1st Qu.:5.000
Median :10.00  Median :5.000
Mean   :13.75  Mean   :4.483
3rd Qu.:19.00  3rd Qu.:5.000
Max.   :32.00  Max.   :6.000
>
> summary(group)
  SCORPIO AUTOMATIC SCORPIO CRDe NGT530  Scorpio Ex m2DiCr  SCORPIO GETAWAY
           591              40           9085              105
  SCORPIO HAWK      SCORPIO M2 DI
           30138             77
>
> library(survival)
>
> # Kaplan-Meier non-parametric analysis
>
> kmsurvival <- survfit(Surv(time,event) ~ 1)
>
> summary(kmsurvival)
Call: survfit(formula = Surv(time, event) ~ 1)

   time n.risk n.event survival  std.err lower 95% CI upper 95% CI
    1  40036   5450  0.86387 0.001714   0.86052   0.86724
    2  34586   4458  0.75252 0.002157   0.74831   0.75676
    3  30128   4877  0.63071 0.002412   0.62600   0.63545
    4  25251   4990  0.50607 0.002499   0.50120   0.51099
    5  20261   4727  0.38800 0.002435   0.38326   0.39280
    6  15534   4139  0.28462 0.002255   0.28023   0.28907
    7  11395   3929  0.18648 0.001947   0.18271   0.19034
    8   7466   3003  0.11147 0.001573   0.10843   0.11460
    9   4463   2242  0.05548 0.001144   0.05328   0.05776
   10   2221   1432  0.01971 0.000695   0.01839   0.02112
   11    789    676  0.00282 0.000265   0.00235   0.00339
   12   113    113  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)
>
> summary(kmsurvival1)
Call: survfit(formula = Surv(time, event) ~ group)
```

group=SCORPIO AUTOMATIC

time	n.risk	n.event	survival	std.err	lower	95% CI	upper	95% CI
1	591	139	0.76481	0.01745	0.731365		0.7998	
2	452	59	0.66497	0.01942	0.627989		0.7041	
3	393	83	0.52453	0.02054	0.485779		0.5664	
4	310	81	0.38748	0.02004	0.350127		0.4288	
5	229	85	0.24365	0.01766	0.211391		0.2808	
6	144	43	0.17090	0.01548	0.143091		0.2041	
7	101	41	0.10152	0.01242	0.079873		0.1290	
8	60	16	0.07445	0.01080	0.056029		0.0989	
9	44	27	0.02876	0.00688	0.018006		0.0460	
10	17	15	0.00338	0.00239	0.000848		0.0135	
11	2	2	0.00000	NaN	NA		NA	

group=SCORPIO CRDe NGT530

time	n.risk	n.event	survival	std.err	lower	95% CI	upper	95% CI
1	40	7	0.825	0.0601	0.7153		0.952	
2	33	2	0.775	0.0660	0.6558		0.916	
3	31	1	0.750	0.0685	0.6271		0.897	
4	30	12	0.450	0.0787	0.3195		0.634	
5	18	7	0.275	0.0706	0.1663		0.455	
6	11	4	0.175	0.0601	0.0893		0.343	
7	7	2	0.125	0.0523	0.0551		0.284	
8	5	3	0.050	0.0345	0.0130		0.193	
10	2	2	0.000	NaN	NA		NA	

group=Scorpio Ex m2DiCr

time	n.risk	n.event	survival	std.err	lower	95% CI	upper	95% CI
1	9085	1459	0.83941	0.003852	0.83189		0.84699	
2	7626	1097	0.71866	0.004718	0.70947		0.72796	
3	6529	1145	0.59263	0.005155	0.58261		0.60282	
4	5384	933	0.48993	0.005245	0.47976		0.50032	
5	4451	1063	0.37292	0.005073	0.36311		0.38300	
6	3388	915	0.27221	0.004670	0.26321		0.28152	
7	2473	854	0.17821	0.004015	0.17051		0.18625	
8	1619	700	0.10116	0.003164	0.09514		0.10755	
9	919	413	0.05570	0.002406	0.05117		0.06062	
10	506	346	0.01761	0.001380	0.01510		0.02053	
11	160	127	0.00363	0.000631	0.00258		0.00511	
12	33	33	0.00000	NaN	NA		NA	

group=SCORPIO GETAWAY

time	n.risk	n.event	survival	std.err	lower	95% CI	upper	95% CI
1	105	20	0.8095	0.0383	0.7378		0.8882	
2	85	18	0.6381	0.0469	0.5525		0.7370	
3	67	11	0.5333	0.0487	0.4460		0.6378	
4	56	14	0.4000	0.0478	0.3165		0.5056	
5	42	15	0.2571	0.0427	0.1858		0.3559	
6	27	5	0.2095	0.0397	0.1445		0.3038	
7	22	4	0.1714	0.0368	0.1126		0.2610	
8	18	14	0.0381	0.0187	0.0146		0.0996	
9	4	4	0.0000	NaN	NA		NA	

group=SCORPIO HAWK

time	n.risk	n.event	survival	std.err	lower 95% CI	upper 95% CI
1	30138	3818	0.87332	0.001916	0.86957	0.8771
2	26320	3271	0.76478	0.002443	0.76001	0.7696
3	23049	3629	0.64437	0.002757	0.63899	0.6498
4	19420	3940	0.51364	0.002879	0.50803	0.5193
5	15480	3548	0.39591	0.002817	0.39043	0.4015
6	11932	3155	0.29123	0.002617	0.28614	0.2964
7	8777	3021	0.19099	0.002264	0.18660	0.1955
8	5756	2263	0.11590	0.001844	0.11234	0.1196
9	3493	1797	0.05627	0.001327	0.05373	0.0589
10	1696	1069	0.02080	0.000822	0.01925	0.0225
11	627	547	0.00265	0.000296	0.00213	0.0033
12	80	80	0.00000	NaN	NA	NA

group=SCORPIO M2 DI

time	n.risk	n.event	survival	std.err	lower 95% CI	upper 95% CI
1	77	7	0.909	0.0328	0.84710	0.976
2	70	11	0.766	0.0482	0.67730	0.867
3	59	8	0.662	0.0539	0.56470	0.777
4	51	10	0.532	0.0569	0.43191	0.656
5	41	9	0.416	0.0562	0.31888	0.542
6	32	17	0.195	0.0451	0.12370	0.307
7	15	7	0.104	0.0348	0.05392	0.200
8	8	7	0.013	0.0129	0.00185	0.091
9	1	1	0.000	NaN	NA	NA

```

>
> plot(kmsurvival1, xlab="Time", ylab="Survival Probability",col=2:7)
>
> # End of Kaplan-Meier non-parametric analysis by group
>
>
> # Nelson-Aalen non-parametric analysis
>
> nasurvival <- survfit(coxph(Surv(time,event)~1), type="aalen")
>
> summary(nasurvival)
Call: survfit(formula = coxph(Surv(time, event) ~ 1), type = "aalen")

```

time	n.risk	n.event	survival	std.err	lower 95% CI	upper 95% CI
1	40036	5450	0.87273	0.001609	0.86958	0.87589
2	34586	4458	0.76719	0.002048	0.76318	0.77121
3	30128	4877	0.65253	0.002307	0.64802	0.65707
4	25251	4990	0.53552	0.002414	0.53081	0.54027
5	20261	4727	0.42409	0.002393	0.41942	0.42880
6	15534	4139	0.32489	0.002274	0.32046	0.32938
7	11395	3929	0.23014	0.002049	0.22616	0.23419
8	7466	3003	0.15392	0.001776	0.15048	0.15745
9	4463	2242	0.09314	0.001460	0.09032	0.09605
10	2221	1432	0.04888	0.001132	0.04671	0.05115
11	789	676	0.02075	0.000836	0.01918	0.02245
12	113	113	0.00763	0.000781	0.00625	0.00933

```

>
> 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') -> out.weib
>
> summary(out.weib)

```

Call:

```
survreg(formula = Surv(time, event) ~ group, dist = "weibull")
              Value Std. Error      z      p
(Intercept)    1.5209    0.02268  67.068 0.00e+00
groupSCORPIO CRDe NGT530  0.0816    0.08996   0.907 3.65e-01
groupScorpio Ex m2DiCr   0.1430    0.02338  6.116 9.57e-10
groupSCORPIO GETAWAY     0.0158    0.05831   0.272 7.86e-01
groupSCORPIO HAWK        0.1769    0.02287  7.734 1.04e-14
groupSCORPIO M2 DI       0.0900    0.06671   1.350 1.77e-01
Log(scale)       -0.5967    0.00404 -147.623 0.00e+00
```

Scale= 0.551

Weibull distribution

Loglik(model)= -94389.7 Loglik(intercept only)= -94432.5

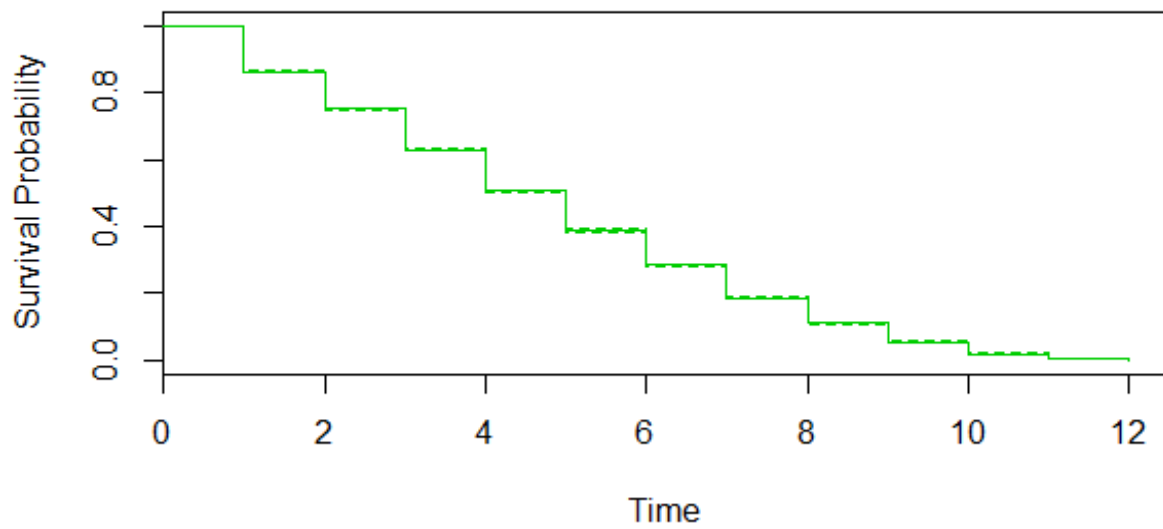
Chisq= 85.6 on 5 degrees of freedom, p= 1.1e-16

Number of Newton-Raphson Iterations: 7

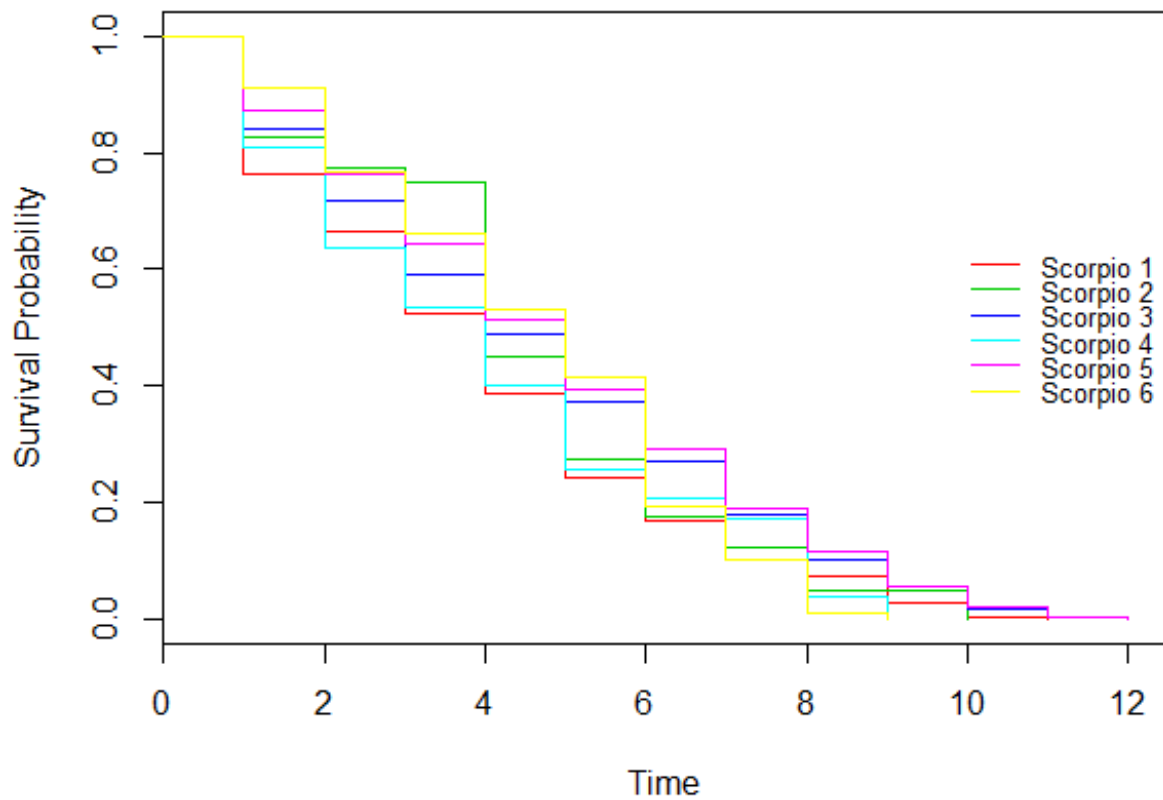
n= 40036

```
>
> 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('Scorpio',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('Scorpio',1:6), col=1:6, lty=1, cex=.8, bty='n')
>
> #End of Weibull Failure Analysis
>
```

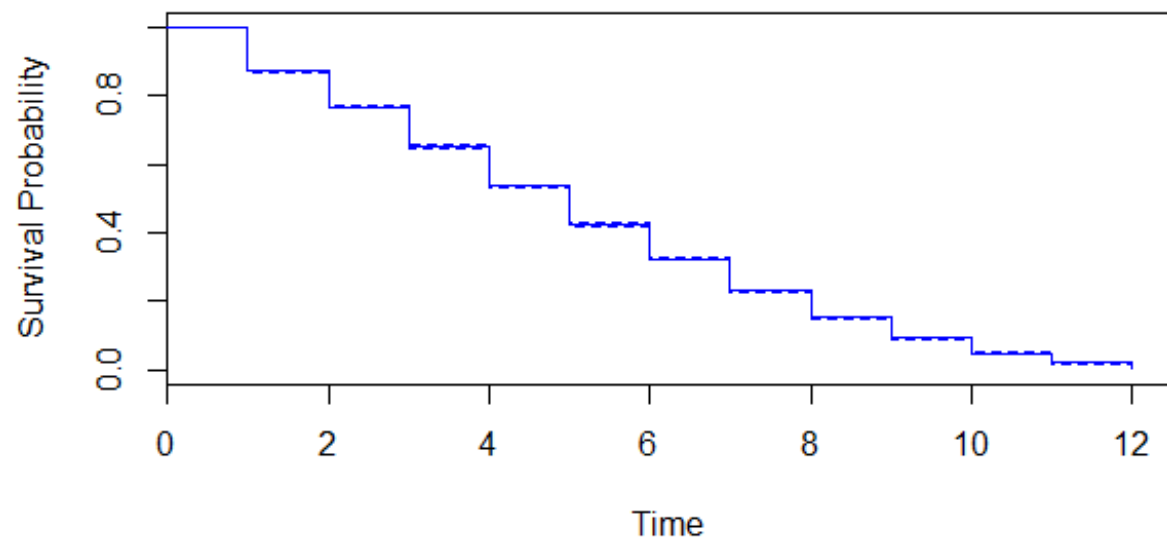
```
> #Weibull Density
>
> curve(dweibull(x, scale=exp(coef(out.weib)[1]),shape=1/out.weib$scale), from=0, to=16, ylab="Density",xlab="months",axes=F)
> axis(1,cex.axis=.8)
> axis(2,cex.axis=.8)
> box()
> curve(dweibull(x, scale=exp(coef(out.weib)[1]+ coef(out.weib)[2]), shape=1/out.weib$scale), from=0, 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('Scorpio',1:6), col=1:6, lty=1, cex=.8, bty='n')
>
> #End of Weibull Density
>
```



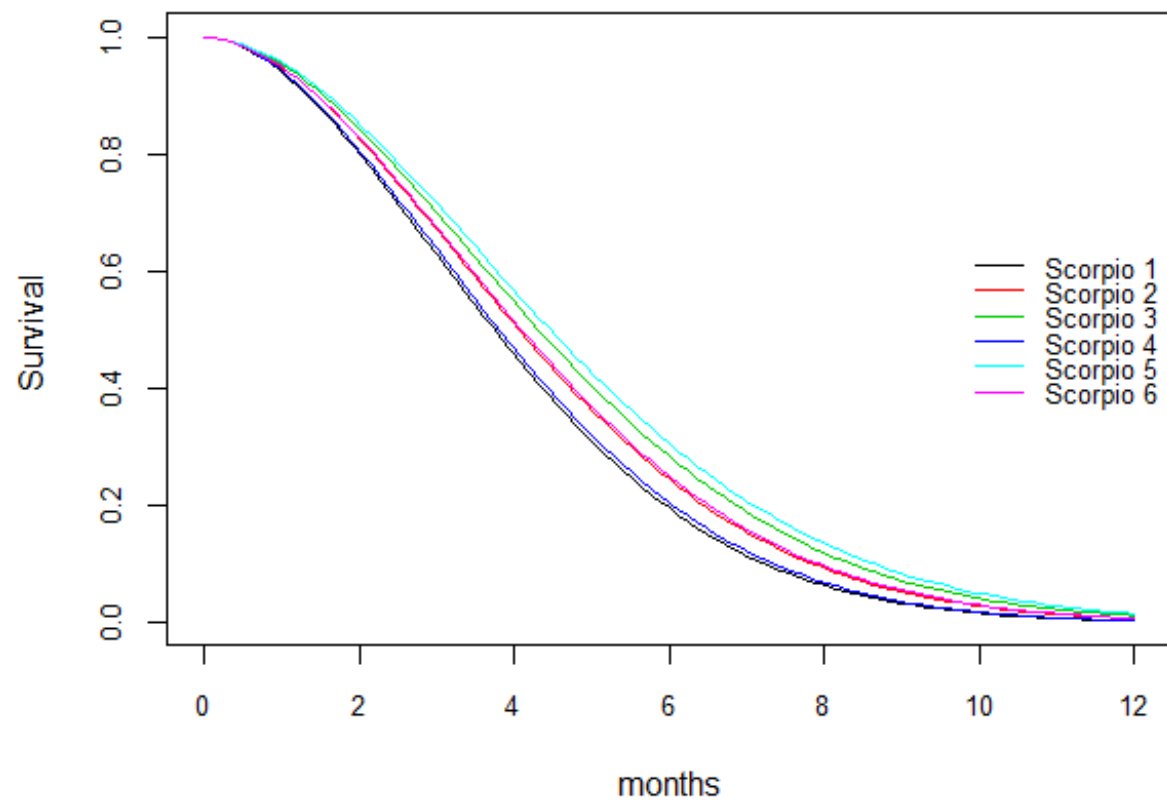
KAPLAN MEIER NON PARAMETRIC ANALYSIS



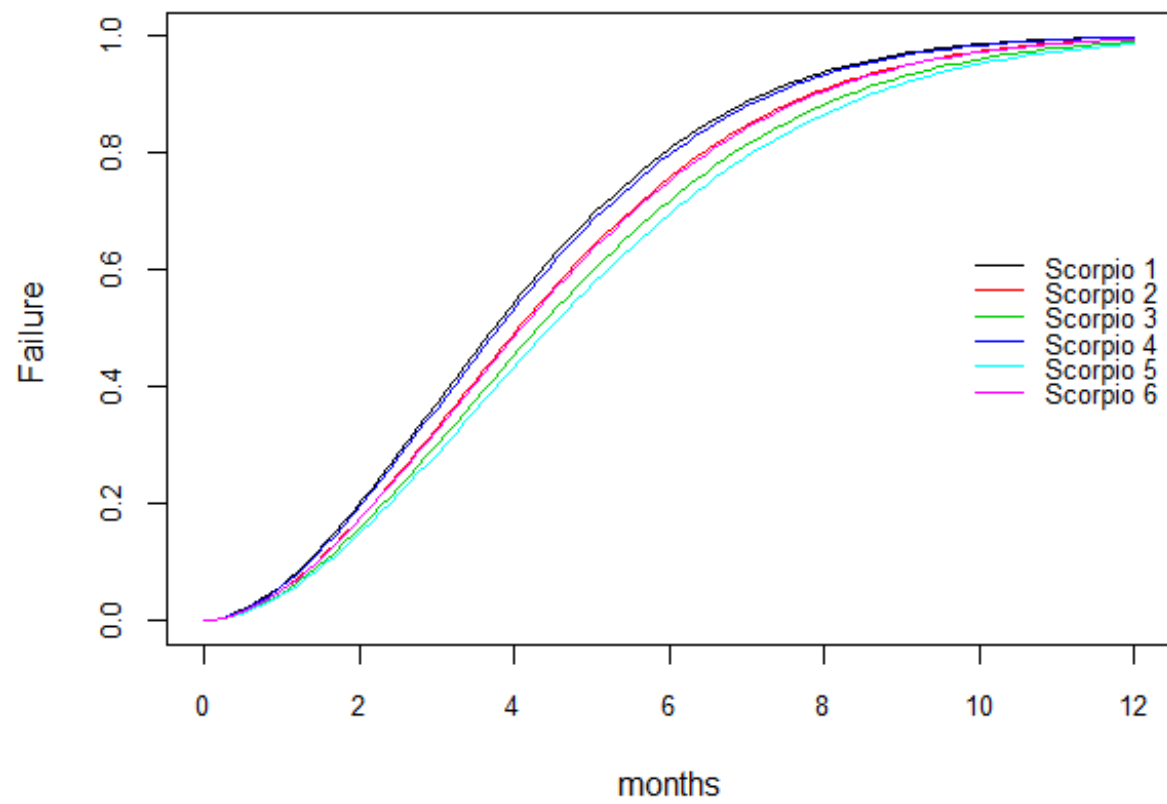
KAPLAN MEIER NON PARAMETRIC ANALYSIS BY GROUP



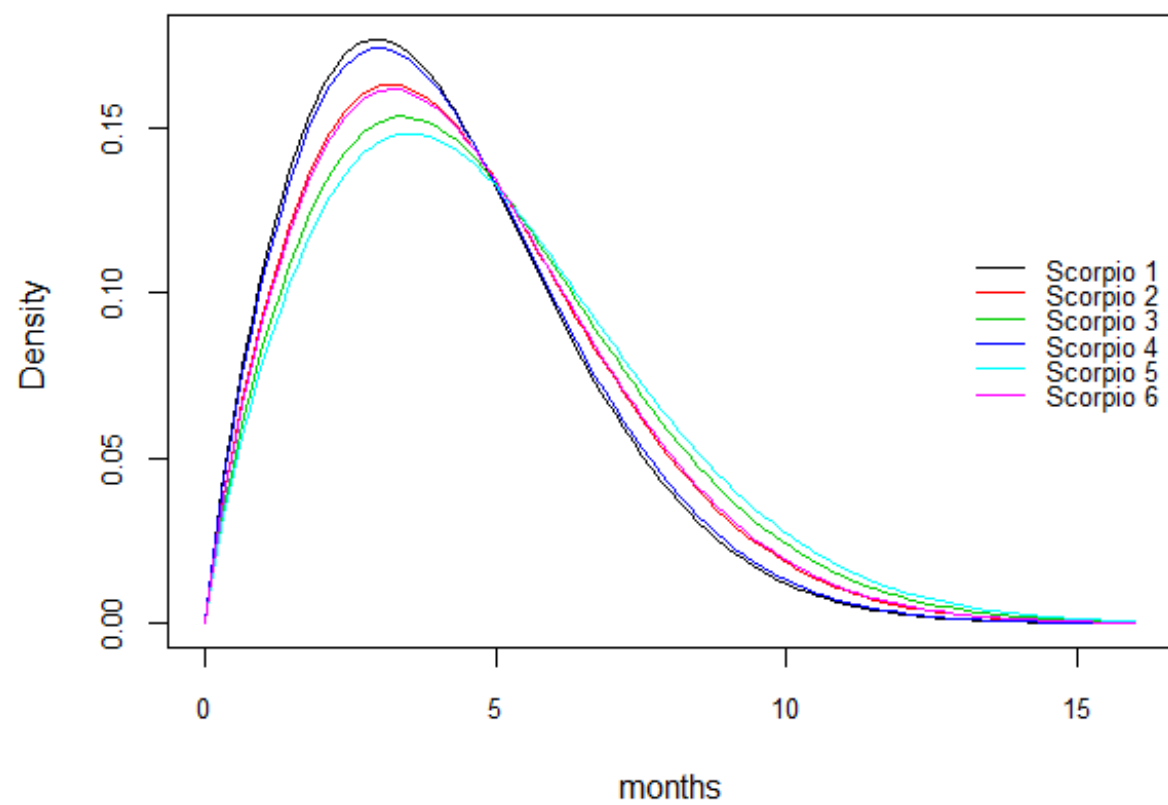
NELSON-AALEN NON PARAMETRIC ANALYSIS



WEIBULL SURVIVAL ANALYSIS



WEIBULL FAILURE ANALYSIS



WEIBULL DENSITY