ERIC BAIR - STAT 262 - PROBLEM SET 3 SOLUTIONS

1. Problem 1

Parts (a) and (b):

Perform the following commands in R:

```
> heart.st <- c(1,3,4,10,12,18,1,3,6,10,11,12)
> heart.c <- c(1,1,0,1,1,1,1,1,1,1,1,0)
> heart.s <- Surv(heart.s,heart.c)
> gender <- factor(c(rep("M",6),rep("F",6)))
> summary(survfit(heart.s~gender))
Call: survfit(formula = heart.s ~ gender)

                gender=F
 time n.risk n.event survival std.err lower 95% CI upper 95% CI
    1      6       1    0.833   0.152       0.5827        1.000
    3      5       1    0.667   0.192       0.3786        1.000
    6      4       1    0.500   0.204       0.2246        1.000
   10      3       1    0.333   0.192       0.1075        1.000
   11      2       1    0.167   0.152       0.0278        0.997

                gender=M
 time n.risk n.event survival std.err lower 95% CI upper 95% CI
    1      6       1    0.833   0.152       0.5827            1
    3      5       1    0.667   0.192       0.3786            1
   10      3       1    0.444   0.222       0.1668            1
   12      2       1    0.222   0.192       0.0407            1
   18      1       1    0.000      NA           NA           NA
```

Part (c):

To find the median survival time, take the first time where $S(t)$ drops below 0.5. If there is an interval for which $S(t) = 0.5$ exactly, take the midpoint of that interval. (For example, the median survival time is 10 for men and 8 for women.) To find the lower 95% confidence interval for the median, take the first time where the lower 95% confidence interval for $S(t)$ drops below 0.5. Similarly, to find the upper 95% confidence interval for the median, take the first time where the lower 95% confidence interval for $S(t)$ drops below 0.5. The procedure for finding other quantiles is analogous. The results are given in the table below.

Part (d):

Execute the following command in R:

	Men			Women		
Quantile	Point	Lower	Upper	Point	Lower	Upper
25th	3	1	∞	3	1	∞
50th	10	3	∞	8	3	∞
75th	12	10	∞	11	6	∞

```
> survfit(heart.s~gender)
Call: survfit(formula = heart.s ~ gender)

         n events rmean se(rmean) median 0.95LCL 0.95UCL
gender=F 6      5  7.17      1.69      8       3     Inf
gender=M 6      5  9.56      2.55     10       3     Inf
```

The mean survival time is 9.56 for men and 7.17 for women.

Part (e):

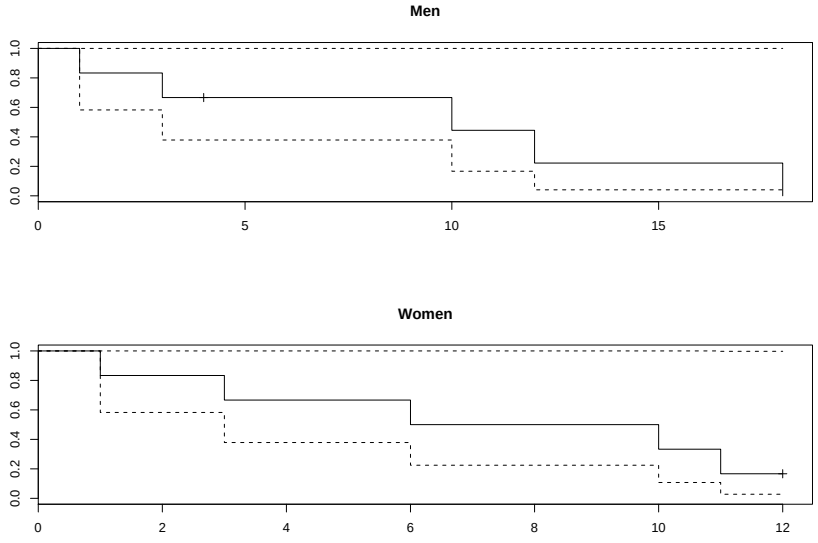
To plot the survival curve for men, execute the following command in R:

```
> plot(survfit(heart.s[1:6]))
```

To plot the survival curve for women, execute the following command in R:

```
> plot(survfit(heart.s[7:12]))
```

The plots are shown below:



2. Problem 2

Parts (a) and (b):

Execute the following commands in R:

```
> whas <- read.csv("whas.csv")
> whas <- subset(whas, yrgrp==1)
> attach(whas)
> summary(survfit(Surv(lenfol,fstat)~sex))
Call: survfit(formula = Surv(lenfol, fstat) ~ sex)

                sex=0
 time n.risk n.event survival std.err lower 95% CI upper 95% CI
    2    101       1    0.990 0.00985        0.971        1.000
    3    100       2    0.970 0.01689        0.938        1.000
    4     98       3    0.941 0.02352        0.896        0.988
    5     95       2    0.921 0.02687        0.870        0.975
    8     93       1    0.911 0.02835        0.857        0.968
    9     92       1    0.901 0.02972        0.845        0.961
   10     91       1    0.891 0.03100        0.832        0.954
   13     90       1    0.881 0.03220        0.820        0.947
   14     89       2    0.861 0.03438        0.797        0.931
   18     87       1    0.851 0.03538        0.785        0.924
   21     86       1    0.842 0.03633        0.773        0.916
   60     85       1    0.832 0.03723        0.762        0.908
   98     84       1    0.822 0.03808        0.750        0.900
  107     83       1    0.812 0.03889        0.739        0.892
  116     82       1    0.802 0.03965        0.728        0.884
  144     81       1    0.792 0.04038        0.717        0.875
  218     80       1    0.782 0.04107        0.706        0.867
  239     79       1    0.772 0.04173        0.695        0.859
  259     78       1    0.762 0.04235        0.684        0.850
  262     77       1    0.752 0.04294        0.673        0.842
  326     76       1    0.743 0.04350        0.662        0.833
  367     75       1    0.733 0.04404        0.651        0.824
  386     74       1    0.723 0.04454        0.641        0.816
  410     73       1    0.713 0.04502        0.630        0.807
  417     72       1    0.703 0.04547        0.619        0.798
  518     71       1    0.693 0.04589        0.609        0.789
  538     70       1    0.683 0.04629        0.598        0.780
  618     69       1    0.673 0.04667        0.588        0.771
  623     68       1    0.663 0.04702        0.577        0.762
  733     67       1    0.653 0.04735        0.567        0.753
  871     66       1    0.644 0.04766        0.557        0.744
 1031     65       1    0.634 0.04794        0.546        0.735
 1267     64       1    0.624 0.04820        0.536        0.726
 1442     63       1    0.614 0.04844        0.526        0.717
 1614     62       1    0.604 0.04866        0.516        0.707
 1696     61       1    0.594 0.04886        0.506        0.698
 1867     60       1    0.584 0.04904        0.496        0.689
 1869     59       1    0.574 0.04920        0.485        0.679
 1902     58       1    0.564 0.04934        0.475        0.670
 1912     57       1    0.554 0.04946        0.466        0.660
```

```
1932     56       1    0.545 0.04955        0.456        0.651
2029     55       1    0.535 0.04963        0.446        0.641
2050     54       1    0.525 0.04969        0.436        0.632
2114     53       1    0.515 0.04973        0.426        0.622
2142     52       1    0.505 0.04975        0.416        0.613
2564     51       1    0.495 0.04975        0.407        0.603
2868     50       1    0.485 0.04973        0.397        0.593
2922     49       1    0.475 0.04969        0.387        0.583
3103     48       1    0.465 0.04963        0.378        0.574
3139     47       1    0.455 0.04955        0.368        0.564
3171     46       1    0.446 0.04946        0.358        0.554
3361     45       1    0.436 0.04934        0.349        0.544
4007     44       1    0.426 0.04920        0.339        0.534
4105     43       1    0.416 0.04904        0.330        0.524
4162     42       1    0.406 0.04886        0.321        0.514
4172     41       1    0.396 0.04866        0.311        0.504
4514     32       1    0.384 0.04869        0.299        0.492

                sex=1
 time n.risk n.event survival std.err lower 95% CI upper 95% CI
    1     59       4    0.932  0.0327        0.870        0.999
    2     55       3    0.881  0.0421        0.803        0.968
    3     52       2    0.847  0.0468        0.761        0.944
    4     50       2    0.814  0.0507        0.720        0.919
    6     48       2    0.780  0.0540        0.681        0.893
   10     46       1    0.763  0.0554        0.662        0.879
   13     45       1    0.746  0.0567        0.643        0.866
   16     44       1    0.729  0.0579        0.624        0.852
   20     43       1    0.712  0.0590        0.605        0.837
   43     42       1    0.695  0.0599        0.587        0.823
   49     41       1    0.678  0.0608        0.569        0.808
   53     40       1    0.661  0.0616        0.551        0.794
  281     39       1    0.644  0.0623        0.533        0.779
  346     38       1    0.627  0.0630        0.515        0.763
  548     37       1    0.610  0.0635        0.498        0.748
 1363     36       1    0.593  0.0640        0.480        0.733
 1653     35       1    0.576  0.0643        0.463        0.717
 1654     34       1    0.559  0.0646        0.446        0.701
 1748     33       1    0.542  0.0649        0.429        0.686
 1815     32       1    0.525  0.0650        0.412        0.670
 2060     31       1    0.508  0.0651        0.396        0.653
 2187     30       1    0.492  0.0651        0.379        0.637
 2335     29       1    0.475  0.0650        0.363        0.621
 2936     28       1    0.458  0.0649        0.347        0.604
 3071     27       1    0.441  0.0646        0.331        0.587
 3078     26       1    0.424  0.0643        0.315        0.571
 3207     25       1    0.407  0.0640        0.299        0.554
 3280     24       1    0.390  0.0635        0.283        0.536
```

```
3402     23       1    0.373  0.0630       0.268       0.519
3441     22       1    0.356  0.0623       0.253       0.502
3962     21       1    0.339  0.0616       0.237       0.484
4240     20       1    0.322  0.0608       0.222       0.466
```

Part (c):

We find the quantiles as discussed in part 1(c), above. See the table below.

	Men			Women		
Quantile	Point	Lower	Upper	Point	Lower	Upper
25th	326	98	871	13	4	548
50th	2564	1867	4514	2187	548	3962
75th	NA	NA	NA	NA	4240	∞

Part (d):

Execute the following command in R:

```
> survfit(Surv(lenfol,fstat)~sex)
Call: survfit(formula = Surv(lenfol, fstat) ~ sex)

        n events rmean se(rmean) median 0.95LCL 0.95UCL
sex=0 101     62  2990       248   2564    1867    4514
sex=1  59     40  2664       320   2187     548    3962
```

Part (e):

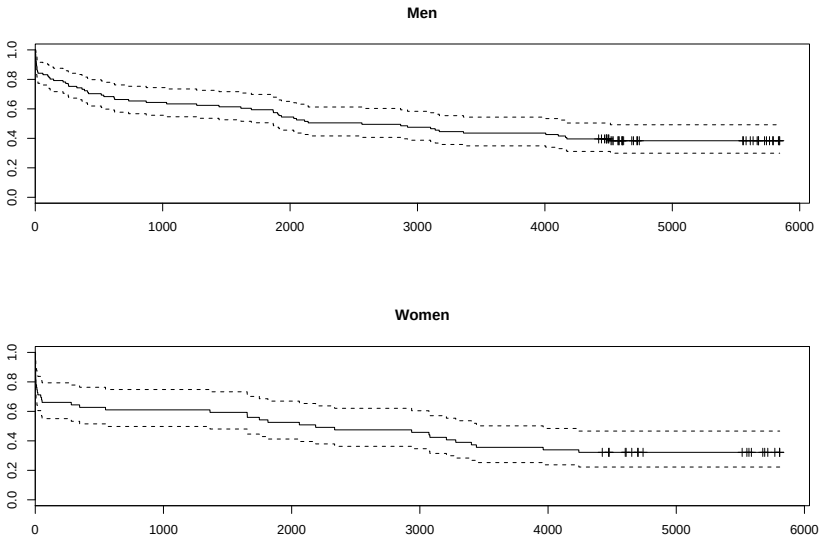
To plot the survival curve for men, execute the following command in R:

```
> plot(survfit(Surv(lenfol,fstat)[sex==0,]))
```

To plot the survival curve for women, execute the following command in R:

```
> plot(survfit(Surv(lenfol,fstat)[sex==1,]))
```

The plots are shown below:



Part (f):

To compare the two survival curves, execute the following command in R:

```
> survdiff(Surv(lenfol,fstat)~sex)
Call:
survdiff(formula = Surv(lenfol, fstat) ~ sex)

        N Observed Expected (O-E)^2/E (O-E)^2/V
sex=0 101       62       67     0.369      1.08
sex=1  59       40       35     0.706      1.08

 Chisq= 1.1  on 1 degrees of freedom, p= 0.298
```

We fail to reject the hypothesis that men and women have equal survival.