Lung cancer survival analysis (female vs male)

This is an R Markdown Notebook. When you execute code within the notebook, the results appear beneath the code.

Try executing this chunk by clicking the *Run* button within the chunk or by placing your cursor inside it and pressing *Ctrl+Shift+Enter*.

```
library(dplyr)
```

```
##
## Attaching package: 'dplyr'

## The following objects are masked from 'package:stats':
##
##     filter, lag

## The following objects are masked from 'package:base':
##
##     intersect, setdiff, setequal, union
```

```
library(survival)
library(survminer)
```

```
## Loading required package: ggplot2

## Loading required package: ggpubr

##
## Attaching package: 'survminer'

## The following object is masked from 'package:survival':
##
##     myeloma
```

```
library(survival)
?lung
```

```
## starting httpd help server ... done
```

```
head(lung)
```

```
##   inst time status age sex ph.ecog ph.karno pat.karno meal.cal wt.loss
## 1    3  306      2  74   1       1       90       100     1175      NA
## 2    3  455      2  68   1       0       90        90     1225      15
## 3    3 1010      1  56   1       0       90        90       NA      15
## 4    5  210      2  57   1       1       90        60     1150      11
## 5    1  883      2  60   1       0      100        90       NA       0
## 6   12 1022      1  74   1       1       50        80      513       0
```

```
class(lung)
```

```
## [1] "data.frame"
```

```
dim(lung)
```

```
## [1] 228  10
```

```
View(lung)
# Replace 'copd.csv' with the desired file path and name
write.csv(lung, "C:/Users/linan/Documents/GitHub/project/R-project/cox-regression-analysis/lung.csv", r
```

```
as_tibble(lung)
```

```
## # A tibble: 228 x 10
##     inst  time status   age   sex ph.ecog ph.karno pat.karno meal.cal wt.loss
##    <dbl> <dbl>  <dbl> <dbl> <dbl>   <dbl>    <dbl>     <dbl>    <dbl>   <dbl>
##  1     3   306      2    74     1       1       90       100     1175      NA
##  2     3   455      2    68     1       0       90        90     1225      15
##  3     3  1010      1    56     1       0       90        90       NA      15
##  4     5   210      2    57     1       1       90        60     1150      11
##  5     1   883      2    60     1       0      100        90       NA       0
##  6    12  1022      1    74     1       1       50        80      513       0
##  7     7   310      2    68     2       2       70        60      384      10
##  8    11   361      2    71     2       2       60        80      538       1
##  9     1   218      2    53     1       1       70        80      825      16
## 10     7   166      2    61     1       2       70        70      271      34
## # i 218 more rows
```

```
lung <- as_tibble(lung)
lung
```

```
## # A tibble: 228 x 10
##     inst  time status   age   sex ph.ecog ph.karno pat.karno meal.cal wt.loss
##    <dbl> <dbl>  <dbl> <dbl> <dbl>   <dbl>    <dbl>     <dbl>    <dbl>   <dbl>
##  1     3   306      2    74     1       1       90       100     1175      NA
##  2     3   455      2    68     1       0       90        90     1225      15
##  3     3  1010      1    56     1       0       90        90       NA      15
##  4     5   210      2    57     1       1       90        60     1150      11
##  5     1   883      2    60     1       0      100        90       NA       0
##  6    12  1022      1    74     1       1       50        80      513       0
##  7     7   310      2    68     2       2       70        60      384      10
```

```
##  8    11   361      2    71     2       2       60        80       538       1
##  9     1   218      2    53     1       1       70        80       825      16
## 10     7   166      2    61     1       2       70        70       271      34
## # i 218 more rows
```

Survival Curves

```
s <- Surv(lung$time, lung$status)
class(s)
```

```
## [1] "Surv"
```

```
s
```

```
##   [1]  306   455  1010+  210   883  1022+  310   361   218   166   170   654
##  [13]  728    71   567   144   613   707    61    88   301    81   624   371
##  [25]  394   520   574   118   390    12   473    26   533   107    53   122
##  [37]  814   965+   93   731   460   153   433   145   583    95   303   519
##  [49]  643   765   735   189    53   246   689    65     5   132   687   345
##  [61]  444   223   175    60   163    65   208   821+  428   230   840+  305
##  [73]   11   132   226   426   705   363    11   176   791    95   196+  167
##  [85]  806+  284   641   147   740+  163   655   239    88   245   588+   30
##  [97]  179   310   477   166   559+  450   364   107   177   156   529+   11
## [109]  429   351    15   181   283   201   524    13   212   524   288   363
## [121]  442   199   550    54   558   207    92    60   551+  543+  293   202
## [133]  353   511+  267   511+  371   387   457   337   201   404+  222    62
## [145]  458+  356+  353   163    31   340   229   444+  315+  182   156   329
## [157]  364+  291   179   376+  384+  268   292+  142   413+  266+  194   320
## [169]  181   285   301+  348   197   382+  303+  296+  180   186   145   269+
## [181]  300+  284+  350   272+  292+  332+  285   259+  110   286   270    81
## [193]  131   225+  269   225+  243+  279+  276+  135    79    59   240+  202+
## [205]  235+  105   224+  239   237+  173+  252+  221+  185+   92+   13   222+
## [217]  192+  183   211+  175+  197+  203+  116   188+  191+  105+  174+  177+
```

```
head(lung)
```

```
## # A tibble: 6 x 10
##    inst  time status   age   sex ph.ecog ph.karno pat.karno meal.cal wt.loss
##   <dbl> <dbl>  <dbl> <dbl> <dbl>   <dbl>    <dbl>     <dbl>    <dbl>   <dbl>
## 1     3   306      2    74     1       1       90       100     1175      NA
## 2     3   455      2    68     1       0       90        90     1225      15
## 3     3  1010      1    56     1       0       90        90       NA      15
## 4     5   210      2    57     1       1       90        60     1150      11
## 5     1   883      2    60     1       0      100        90       NA       0
## 6    12  1022      1    74     1       1       50        80      513       0
```

```
survfit(s~1)
```

```
## Call: survfit(formula = s ~ 1)
##
##        n events median 0.95LCL 0.95UCL
## [1,] 228    165    310     285     363
```

```r
survfit(Surv(time, status)~1, data=lung)
```

```
## Call: survfit(formula = Surv(time, status) ~ 1, data = lung)
##
##        n events median 0.95LCL 0.95UCL
## [1,] 228    165    310     285     363
```

```r
sfit <- survfit(Surv(time, status)~1, data=lung)
sfit
```

```
## Call: survfit(formula = Surv(time, status) ~ 1, data = lung)
##
##        n events median 0.95LCL 0.95UCL
## [1,] 228    165    310     285     363
```

```r
summary(sfit)
```

```
## Call: survfit(formula = Surv(time, status) ~ 1, data = lung)
##
##  time n.risk n.event survival std.err lower 95% CI upper 95% CI
##     5    228       1   0.9956 0.00438       0.9871        1.000
##    11    227       3   0.9825 0.00869       0.9656        1.000
##    12    224       1   0.9781 0.00970       0.9592        0.997
##    13    223       2   0.9693 0.01142       0.9472        0.992
##    15    221       1   0.9649 0.01219       0.9413        0.989
##    26    220       1   0.9605 0.01290       0.9356        0.986
##    30    219       1   0.9561 0.01356       0.9299        0.983
##    31    218       1   0.9518 0.01419       0.9243        0.980
##    53    217       2   0.9430 0.01536       0.9134        0.974
##    54    215       1   0.9386 0.01590       0.9079        0.970
##    59    214       1   0.9342 0.01642       0.9026        0.967
##    60    213       2   0.9254 0.01740       0.8920        0.960
##    61    211       1   0.9211 0.01786       0.8867        0.957
##    62    210       1   0.9167 0.01830       0.8815        0.953
##    65    209       2   0.9079 0.01915       0.8711        0.946
##    71    207       1   0.9035 0.01955       0.8660        0.943
##    79    206       1   0.8991 0.01995       0.8609        0.939
##    81    205       2   0.8904 0.02069       0.8507        0.932
##    88    203       2   0.8816 0.02140       0.8406        0.925
##    92    201       1   0.8772 0.02174       0.8356        0.921
##    93    199       1   0.8728 0.02207       0.8306        0.917
##    95    198       2   0.8640 0.02271       0.8206        0.910
##   105    196       1   0.8596 0.02302       0.8156        0.906
##   107    194       2   0.8507 0.02362       0.8056        0.898
##   110    192       1   0.8463 0.02391       0.8007        0.894
##   116    191       1   0.8418 0.02419       0.7957        0.891
##   118    190       1   0.8374 0.02446       0.7908        0.887
##   122    189       1   0.8330 0.02473       0.7859        0.883
##   131    188       1   0.8285 0.02500       0.7810        0.879
##   132    187       2   0.8197 0.02550       0.7712        0.871
##   135    185       1   0.8153 0.02575       0.7663        0.867
##   142    184       1   0.8108 0.02598       0.7615        0.863
```

```
##   144   183       1   0.8064 0.02622       0.7566        0.859
##   145   182       2   0.7975 0.02667       0.7469        0.852
##   147   180       1   0.7931 0.02688       0.7421        0.848
##   153   179       1   0.7887 0.02710       0.7373        0.844
##   156   178       2   0.7798 0.02751       0.7277        0.836
##   163   176       3   0.7665 0.02809       0.7134        0.824
##   166   173       2   0.7577 0.02845       0.7039        0.816
##   167   171       1   0.7532 0.02863       0.6991        0.811
##   170   170       1   0.7488 0.02880       0.6944        0.807
##   175   167       1   0.7443 0.02898       0.6896        0.803
##   176   165       1   0.7398 0.02915       0.6848        0.799
##   177   164       1   0.7353 0.02932       0.6800        0.795
##   179   162       2   0.7262 0.02965       0.6704        0.787
##   180   160       1   0.7217 0.02981       0.6655        0.783
##   181   159       2   0.7126 0.03012       0.6559        0.774
##   182   157       1   0.7081 0.03027       0.6511        0.770
##   183   156       1   0.7035 0.03041       0.6464        0.766
##   186   154       1   0.6989 0.03056       0.6416        0.761
##   189   152       1   0.6943 0.03070       0.6367        0.757
##   194   149       1   0.6897 0.03085       0.6318        0.753
##   197   147       1   0.6850 0.03099       0.6269        0.749
##   199   145       1   0.6803 0.03113       0.6219        0.744
##   201   144       2   0.6708 0.03141       0.6120        0.735
##   202   142       1   0.6661 0.03154       0.6071        0.731
##   207   139       1   0.6613 0.03168       0.6020        0.726
##   208   138       1   0.6565 0.03181       0.5970        0.722
##   210   137       1   0.6517 0.03194       0.5920        0.717
##   212   135       1   0.6469 0.03206       0.5870        0.713
##   218   134       1   0.6421 0.03218       0.5820        0.708
##   222   132       1   0.6372 0.03231       0.5769        0.704
##   223   130       1   0.6323 0.03243       0.5718        0.699
##   226   126       1   0.6273 0.03256       0.5666        0.694
##   229   125       1   0.6223 0.03268       0.5614        0.690
##   230   124       1   0.6172 0.03280       0.5562        0.685
##   239   121       2   0.6070 0.03304       0.5456        0.675
##   245   117       1   0.6019 0.03316       0.5402        0.670
##   246   116       1   0.5967 0.03328       0.5349        0.666
##   267   112       1   0.5913 0.03341       0.5294        0.661
##   268   111       1   0.5860 0.03353       0.5239        0.656
##   269   110       1   0.5807 0.03364       0.5184        0.651
##   270   108       1   0.5753 0.03376       0.5128        0.645
##   283   104       1   0.5698 0.03388       0.5071        0.640
##   284   103       1   0.5642 0.03400       0.5014        0.635
##   285   101       2   0.5531 0.03424       0.4899        0.624
##   286    99       1   0.5475 0.03434       0.4841        0.619
##   288    98       1   0.5419 0.03444       0.4784        0.614
##   291    97       1   0.5363 0.03454       0.4727        0.608
##   293    94       1   0.5306 0.03464       0.4669        0.603
##   301    91       1   0.5248 0.03475       0.4609        0.597
##   303    89       1   0.5189 0.03485       0.4549        0.592
##   305    87       1   0.5129 0.03496       0.4488        0.586
##   306    86       1   0.5070 0.03506       0.4427        0.581
##   310    85       2   0.4950 0.03523       0.4306        0.569
##   320    82       1   0.4890 0.03532       0.4244        0.563
```

```
##   329     81       1   0.4830 0.03539       0.4183        0.558
##   337     79       1   0.4768 0.03547       0.4121        0.552
##   340     78       1   0.4707 0.03554       0.4060        0.546
##   345     77       1   0.4646 0.03560       0.3998        0.540
##   348     76       1   0.4585 0.03565       0.3937        0.534
##   350     75       1   0.4524 0.03569       0.3876        0.528
##   351     74       1   0.4463 0.03573       0.3815        0.522
##   353     73       2   0.4340 0.03578       0.3693        0.510
##   361     70       1   0.4278 0.03581       0.3631        0.504
##   363     69       2   0.4154 0.03583       0.3508        0.492
##   364     67       1   0.4092 0.03582       0.3447        0.486
##   371     65       2   0.3966 0.03581       0.3323        0.473
##   387     60       1   0.3900 0.03582       0.3258        0.467
##   390     59       1   0.3834 0.03582       0.3193        0.460
##   394     58       1   0.3768 0.03580       0.3128        0.454
##   426     55       1   0.3700 0.03580       0.3060        0.447
##   428     54       1   0.3631 0.03579       0.2993        0.440
##   429     53       1   0.3563 0.03576       0.2926        0.434
##   433     52       1   0.3494 0.03573       0.2860        0.427
##   442     51       1   0.3426 0.03568       0.2793        0.420
##   444     50       1   0.3357 0.03561       0.2727        0.413
##   450     48       1   0.3287 0.03555       0.2659        0.406
##   455     47       1   0.3217 0.03548       0.2592        0.399
##   457     46       1   0.3147 0.03539       0.2525        0.392
##   460     44       1   0.3076 0.03530       0.2456        0.385
##   473     43       1   0.3004 0.03520       0.2388        0.378
##   477     42       1   0.2933 0.03508       0.2320        0.371
##   519     39       1   0.2857 0.03498       0.2248        0.363
##   520     38       1   0.2782 0.03485       0.2177        0.356
##   524     37       2   0.2632 0.03455       0.2035        0.340
##   533     34       1   0.2554 0.03439       0.1962        0.333
##   550     32       1   0.2475 0.03423       0.1887        0.325
##   558     30       1   0.2392 0.03407       0.1810        0.316
##   567     28       1   0.2307 0.03391       0.1729        0.308
##   574     27       1   0.2221 0.03371       0.1650        0.299
##   583     26       1   0.2136 0.03348       0.1571        0.290
##   613     24       1   0.2047 0.03325       0.1489        0.281
##   624     23       1   0.1958 0.03297       0.1407        0.272
##   641     22       1   0.1869 0.03265       0.1327        0.263
##   643     21       1   0.1780 0.03229       0.1247        0.254
##   654     20       1   0.1691 0.03188       0.1169        0.245
##   655     19       1   0.1602 0.03142       0.1091        0.235
##   687     18       1   0.1513 0.03090       0.1014        0.226
##   689     17       1   0.1424 0.03034       0.0938        0.216
##   705     16       1   0.1335 0.02972       0.0863        0.207
##   707     15       1   0.1246 0.02904       0.0789        0.197
##   728     14       1   0.1157 0.02830       0.0716        0.187
##   731     13       1   0.1068 0.02749       0.0645        0.177
##   735     12       1   0.0979 0.02660       0.0575        0.167
##   765     10       1   0.0881 0.02568       0.0498        0.156
##   791      9       1   0.0783 0.02462       0.0423        0.145
##   814      7       1   0.0671 0.02351       0.0338        0.133
##   883      4       1   0.0503 0.02285       0.0207        0.123
```

```r
sfit <- survfit(Surv(time, status)~sex, data=lung)
sfit
```

```
## Call: survfit(formula = Surv(time, status) ~ sex, data = lung)
##
##         n events median 0.95LCL 0.95UCL
## sex=1 138    112    270     212     310
## sex=2  90     53    426     348     550
```

```r
summary(sfit)
```

```
## Call: survfit(formula = Surv(time, status) ~ sex, data = lung)
##
##                 sex=1
##  time n.risk n.event survival std.err lower 95% CI upper 95% CI
##    11    138       3   0.9783  0.0124       0.9542        1.000
##    12    135       1   0.9710  0.0143       0.9434        0.999
##    13    134       2   0.9565  0.0174       0.9231        0.991
##    15    132       1   0.9493  0.0187       0.9134        0.987
##    26    131       1   0.9420  0.0199       0.9038        0.982
##    30    130       1   0.9348  0.0210       0.8945        0.977
##    31    129       1   0.9275  0.0221       0.8853        0.972
##    53    128       2   0.9130  0.0240       0.8672        0.961
##    54    126       1   0.9058  0.0249       0.8583        0.956
##    59    125       1   0.8986  0.0257       0.8496        0.950
##    60    124       1   0.8913  0.0265       0.8409        0.945
##    65    123       2   0.8768  0.0280       0.8237        0.933
##    71    121       1   0.8696  0.0287       0.8152        0.928
##    81    120       1   0.8623  0.0293       0.8067        0.922
##    88    119       2   0.8478  0.0306       0.7900        0.910
##    92    117       1   0.8406  0.0312       0.7817        0.904
##    93    116       1   0.8333  0.0317       0.7734        0.898
##    95    115       1   0.8261  0.0323       0.7652        0.892
##   105    114       1   0.8188  0.0328       0.7570        0.886
##   107    113       1   0.8116  0.0333       0.7489        0.880
##   110    112       1   0.8043  0.0338       0.7408        0.873
##   116    111       1   0.7971  0.0342       0.7328        0.867
##   118    110       1   0.7899  0.0347       0.7247        0.861
##   131    109       1   0.7826  0.0351       0.7167        0.855
##   132    108       2   0.7681  0.0359       0.7008        0.842
##   135    106       1   0.7609  0.0363       0.6929        0.835
##   142    105       1   0.7536  0.0367       0.6851        0.829
##   144    104       1   0.7464  0.0370       0.6772        0.823
##   147    103       1   0.7391  0.0374       0.6694        0.816
##   156    102       2   0.7246  0.0380       0.6538        0.803
##   163    100       3   0.7029  0.0389       0.6306        0.783
##   166     97       1   0.6957  0.0392       0.6230        0.777
##   170     96       1   0.6884  0.0394       0.6153        0.770
##   175     94       1   0.6811  0.0397       0.6076        0.763
##   176     93       1   0.6738  0.0399       0.5999        0.757
##   177     92       1   0.6664  0.0402       0.5922        0.750
##   179     91       2   0.6518  0.0406       0.5769        0.736
##   180     89       1   0.6445  0.0408       0.5693        0.730
```

```
##   181     88      2   0.6298  0.0412      0.5541      0.716
##   183     86      1   0.6225  0.0413      0.5466      0.709
##   189     83      1   0.6150  0.0415      0.5388      0.702
##   197     80      1   0.6073  0.0417      0.5309      0.695
##   202     78      1   0.5995  0.0419      0.5228      0.687
##   207     77      1   0.5917  0.0420      0.5148      0.680
##   210     76      1   0.5839  0.0422      0.5068      0.673
##   212     75      1   0.5762  0.0424      0.4988      0.665
##   218     74      1   0.5684  0.0425      0.4909      0.658
##   222     72      1   0.5605  0.0426      0.4829      0.651
##   223     70      1   0.5525  0.0428      0.4747      0.643
##   229     67      1   0.5442  0.0429      0.4663      0.635
##   230     66      1   0.5360  0.0431      0.4579      0.627
##   239     64      1   0.5276  0.0432      0.4494      0.619
##   246     63      1   0.5192  0.0433      0.4409      0.611
##   267     61      1   0.5107  0.0434      0.4323      0.603
##   269     60      1   0.5022  0.0435      0.4238      0.595
##   270     59      1   0.4937  0.0436      0.4152      0.587
##   283     57      1   0.4850  0.0437      0.4065      0.579
##   284     56      1   0.4764  0.0438      0.3979      0.570
##   285     54      1   0.4676  0.0438      0.3891      0.562
##   286     53      1   0.4587  0.0439      0.3803      0.553
##   288     52      1   0.4499  0.0439      0.3716      0.545
##   291     51      1   0.4411  0.0439      0.3629      0.536
##   301     48      1   0.4319  0.0440      0.3538      0.527
##   303     46      1   0.4225  0.0440      0.3445      0.518
##   306     44      1   0.4129  0.0440      0.3350      0.509
##   310     43      1   0.4033  0.0441      0.3256      0.500
##   320     42      1   0.3937  0.0440      0.3162      0.490
##   329     41      1   0.3841  0.0440      0.3069      0.481
##   337     40      1   0.3745  0.0439      0.2976      0.471
##   353     39      2   0.3553  0.0437      0.2791      0.452
##   363     37      1   0.3457  0.0436      0.2700      0.443
##   364     36      1   0.3361  0.0434      0.2609      0.433
##   371     35      1   0.3265  0.0432      0.2519      0.423
##   387     34      1   0.3169  0.0430      0.2429      0.413
##   390     33      1   0.3073  0.0428      0.2339      0.404
##   394     32      1   0.2977  0.0425      0.2250      0.394
##   428     29      1   0.2874  0.0423      0.2155      0.383
##   429     28      1   0.2771  0.0420      0.2060      0.373
##   442     27      1   0.2669  0.0417      0.1965      0.362
##   455     25      1   0.2562  0.0413      0.1868      0.351
##   457     24      1   0.2455  0.0410      0.1770      0.341
##   460     22      1   0.2344  0.0406      0.1669      0.329
##   477     21      1   0.2232  0.0402      0.1569      0.318
##   519     20      1   0.2121  0.0397      0.1469      0.306
##   524     19      1   0.2009  0.0391      0.1371      0.294
##   533     18      1   0.1897  0.0385      0.1275      0.282
##   558     17      1   0.1786  0.0378      0.1179      0.270
##   567     16      1   0.1674  0.0371      0.1085      0.258
##   574     15      1   0.1562  0.0362      0.0992      0.246
##   583     14      1   0.1451  0.0353      0.0900      0.234
##   613     13      1   0.1339  0.0343      0.0810      0.221
##   624     12      1   0.1228  0.0332      0.0722      0.209
```

```
##   643     11       1   0.1116  0.0320       0.0636        0.196
##   655     10       1   0.1004  0.0307       0.0552        0.183
##   689      9       1   0.0893  0.0293       0.0470        0.170
##   707      8       1   0.0781  0.0276       0.0390        0.156
##   791      7       1   0.0670  0.0259       0.0314        0.143
##   814      5       1   0.0536  0.0239       0.0223        0.128
##   883      3       1   0.0357  0.0216       0.0109        0.117
##
##                 sex=2
##  time n.risk n.event survival std.err lower 95% CI upper 95% CI
##     5     90       1   0.9889  0.0110       0.9675        1.000
##    60     89       1   0.9778  0.0155       0.9478        1.000
##    61     88       1   0.9667  0.0189       0.9303        1.000
##    62     87       1   0.9556  0.0217       0.9139        0.999
##    79     86       1   0.9444  0.0241       0.8983        0.993
##    81     85       1   0.9333  0.0263       0.8832        0.986
##    95     83       1   0.9221  0.0283       0.8683        0.979
##   107     81       1   0.9107  0.0301       0.8535        0.972
##   122     80       1   0.8993  0.0318       0.8390        0.964
##   145     79       2   0.8766  0.0349       0.8108        0.948
##   153     77       1   0.8652  0.0362       0.7970        0.939
##   166     76       1   0.8538  0.0375       0.7834        0.931
##   167     75       1   0.8424  0.0387       0.7699        0.922
##   182     71       1   0.8305  0.0399       0.7559        0.913
##   186     70       1   0.8187  0.0411       0.7420        0.903
##   194     68       1   0.8066  0.0422       0.7280        0.894
##   199     67       1   0.7946  0.0432       0.7142        0.884
##   201     66       2   0.7705  0.0452       0.6869        0.864
##   208     62       1   0.7581  0.0461       0.6729        0.854
##   226     59       1   0.7452  0.0471       0.6584        0.843
##   239     57       1   0.7322  0.0480       0.6438        0.833
##   245     54       1   0.7186  0.0490       0.6287        0.821
##   268     51       1   0.7045  0.0501       0.6129        0.810
##   285     47       1   0.6895  0.0512       0.5962        0.798
##   293     45       1   0.6742  0.0523       0.5791        0.785
##   305     43       1   0.6585  0.0534       0.5618        0.772
##   310     42       1   0.6428  0.0544       0.5447        0.759
##   340     39       1   0.6264  0.0554       0.5267        0.745
##   345     38       1   0.6099  0.0563       0.5089        0.731
##   348     37       1   0.5934  0.0572       0.4913        0.717
##   350     36       1   0.5769  0.0579       0.4739        0.702
##   351     35       1   0.5604  0.0586       0.4566        0.688
##   361     33       1   0.5434  0.0592       0.4390        0.673
##   363     32       1   0.5265  0.0597       0.4215        0.658
##   371     30       1   0.5089  0.0603       0.4035        0.642
##   426     26       1   0.4893  0.0610       0.3832        0.625
##   433     25       1   0.4698  0.0617       0.3632        0.608
##   444     24       1   0.4502  0.0621       0.3435        0.590
##   450     23       1   0.4306  0.0624       0.3241        0.572
##   473     22       1   0.4110  0.0626       0.3050        0.554
##   520     19       1   0.3894  0.0629       0.2837        0.534
##   524     18       1   0.3678  0.0630       0.2628        0.515
##   550     15       1   0.3433  0.0634       0.2390        0.493
##   641     11       1   0.3121  0.0649       0.2076        0.469
```

```
##   654     10       1   0.2808  0.0655       0.1778        0.443
##   687      9       1   0.2496  0.0652       0.1496        0.417
##   705      8       1   0.2184  0.0641       0.1229        0.388
##   728      7       1   0.1872  0.0621       0.0978        0.359
##   731      6       1   0.1560  0.0590       0.0743        0.328
##   735      5       1   0.1248  0.0549       0.0527        0.295
##   765      3       1   0.0832  0.0499       0.0257        0.270
```

```
# ?summary.survfit
range(lung$time)
```

```
## [1]    5 1022
```

```
seq(0, 1100, 100)
```

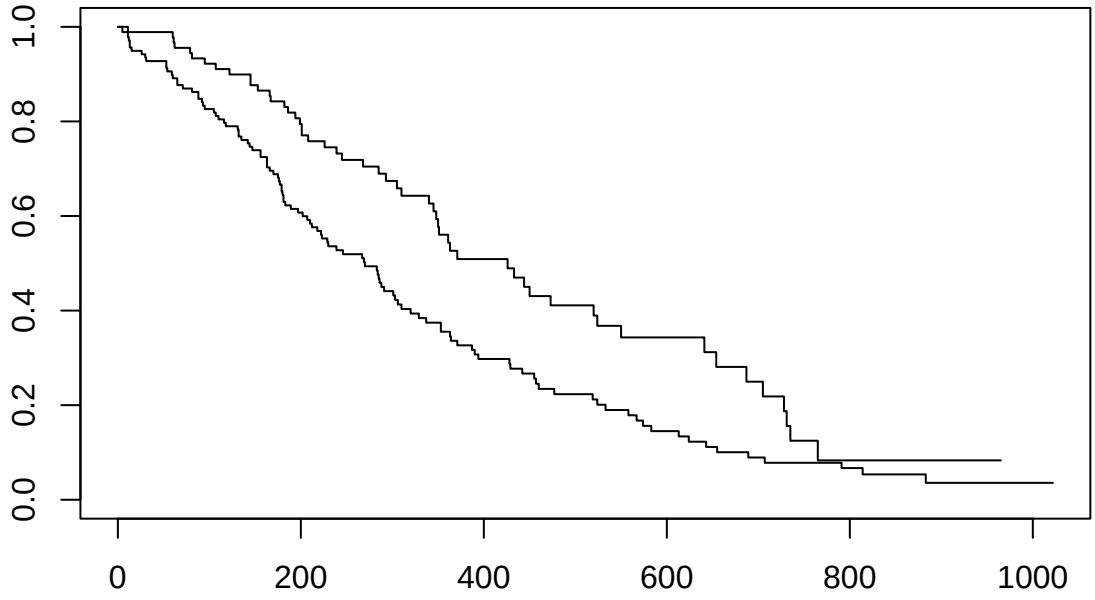
```
##  [1]    0  100  200  300  400  500  600  700  800  900 1000 1100
```

```
summary(sfit, times=seq(0, 1000, 100))
```

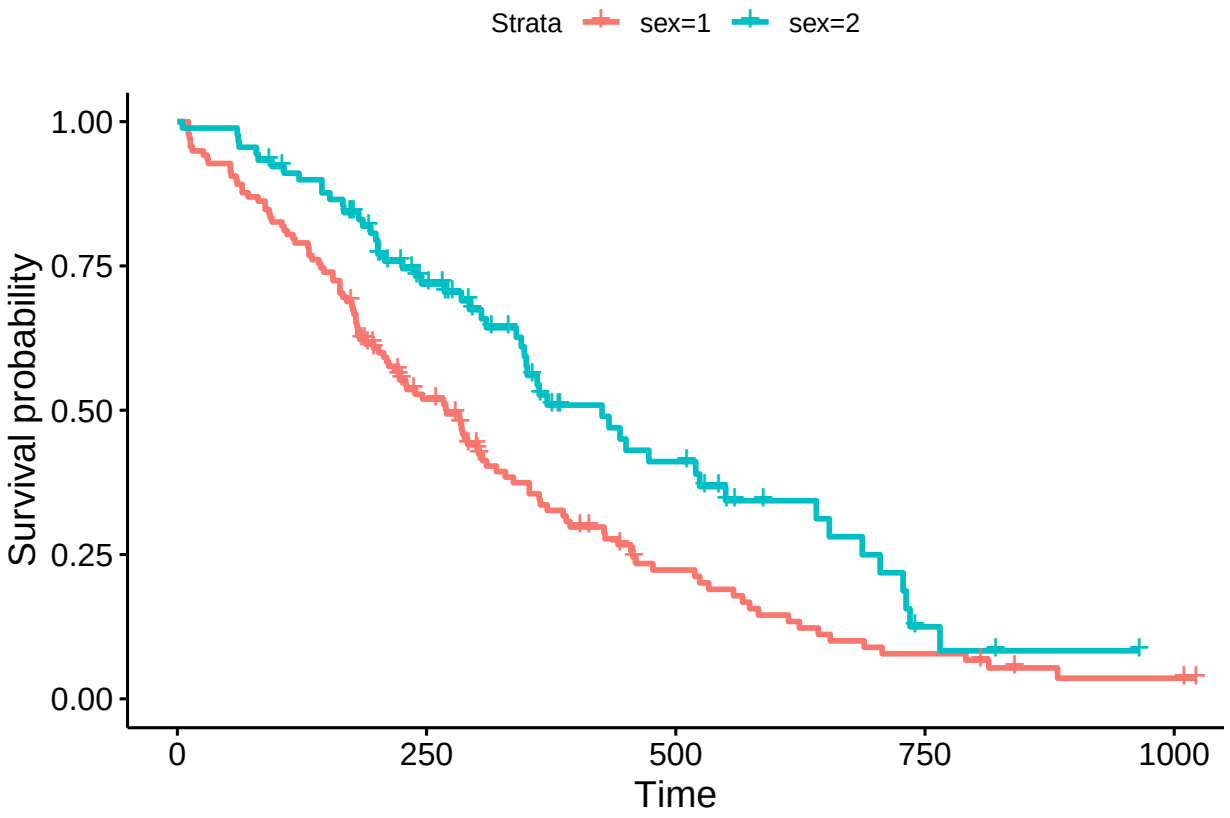
```
## Call: survfit(formula = Surv(time, status) ~ sex, data = lung)
##
##                 sex=1
##  time n.risk n.event survival std.err lower 95% CI upper 95% CI
##     0    138       0   1.0000  0.0000       1.0000        1.000
##   100    114      24   0.8261  0.0323       0.7652        0.892
##   200     78      30   0.6073  0.0417       0.5309        0.695
##   300     49      20   0.4411  0.0439       0.3629        0.536
##   400     31      15   0.2977  0.0425       0.2250        0.394
##   500     20       7   0.2232  0.0402       0.1569        0.318
##   600     13       7   0.1451  0.0353       0.0900        0.234
##   700      8       5   0.0893  0.0293       0.0470        0.170
##   800      6       2   0.0670  0.0259       0.0314        0.143
##   900      2       2   0.0357  0.0216       0.0109        0.117
##  1000      2       0   0.0357  0.0216       0.0109        0.117
##
##                 sex=2
##  time n.risk n.event survival std.err lower 95% CI upper 95% CI
##     0     90       0   1.0000  0.0000       1.0000        1.000
##   100     82       7   0.9221  0.0283       0.8683        0.979
##   200     66      11   0.7946  0.0432       0.7142        0.884
##   300     43       9   0.6742  0.0523       0.5791        0.785
##   400     26      10   0.5089  0.0603       0.4035        0.642
##   500     21       5   0.4110  0.0626       0.3050        0.554
##   600     11       3   0.3433  0.0634       0.2390        0.493
##   700      8       3   0.2496  0.0652       0.1496        0.417
##   800      2       5   0.0832  0.0499       0.0257        0.270
##   900      1       0   0.0832  0.0499       0.0257        0.270
```

Kaplan-Meier Plots

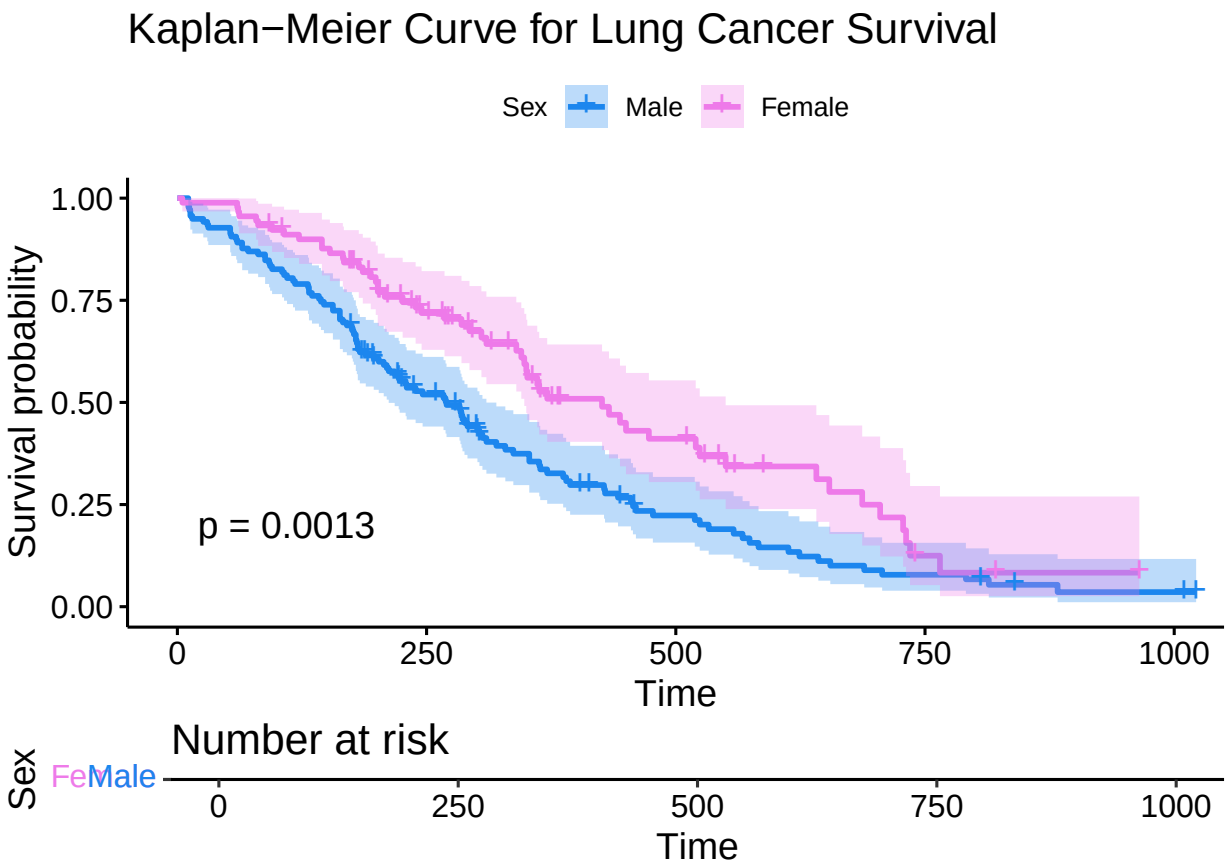
```
sfit <- survfit(Surv(time, status)~sex, data=lung)
plot(sfit)
```




```
library(survminer)
ggsurvplot(sfit)
```




```
ggsurvplot(sfit, conf.int=TRUE, pval=TRUE, risk.table=TRUE,
           legend.labs=c("Male", "Female"), legend.title="Sex",
           palette=c("dodgerblue2", "orchid2"),
           title="Kaplan-Meier Curve for Lung Cancer Survival",
           risk.table.height=.15)
```




```
# Fit a Cox proportional hazards model
cox_fit <- coxph(Surv(time, status) ~ age + sex + ph.ecog, data=lung)

# Summarize the Cox model
summary(cox_fit)
```

```
## Call:
## coxph(formula = Surv(time, status) ~ age + sex + ph.ecog, data = lung)
##
##   n= 227, number of events= 164
##    (1 observation deleted due to missingness)
##
##              coef exp(coef)  se(coef)      z Pr(>|z|)
## age      0.011067  1.011128  0.009267  1.194 0.232416
## sex     -0.552612  0.575445  0.167739 -3.294 0.000986 ***
## ph.ecog  0.463728  1.589991  0.113577  4.083 4.45e-05 ***
## ---
## Signif. codes:  0 '***' 0.001 '**' 0.01 '*' 0.05 '.' 0.1 ' ' 1
##
##          exp(coef) exp(-coef) lower .95 upper .95
## age         1.0111     0.9890    0.9929    1.0297
## sex         0.5754     1.7378    0.4142    0.7994
## ph.ecog     1.5900     0.6289    1.2727    1.9864
##
## Concordance= 0.637  (se = 0.025 )
## Likelihood ratio test= 30.5  on 3 df,   p=1e-06
```

```
## Wald test            = 29.93  on 3 df,   p=1e-06
## Score (logrank) test = 30.5  on 3 df,   p=1e-06
```

```
# Visualize the Cox proportional hazards model results
ggforest(cox_fit, data = lung)
```