Parametric analysis (I part)

Data description: The heart dataset contains information on 103 patients on the waiting list for the Stanford heart transplant program. The esposure of interest is the effect of the transplant on death. The status variable is 1 for death and 0 for everything else. Time to event is recorded in days. The main aim of this study is to evaluate if the transplant is protective for death.

1. Working on the pooled sample:

```
. cd "working directory path"
. use heart.dta,clear
. des

Contains data from heart.dta
  obs:           103
 vars:            10                          24 Apr 2015 22:58
 size:         5,665 (99.9% of memory free)
-------------------------------------------------------------------------------
              storage  display     value
variable name   type   format      label      variable label
-------------------------------------------------------------------------------
id              int    %8.0g                  identity number
birthdt         str10  %10s                   birth date
acceptdt        str10  %10s                   acceptance into program
txdate          str10  %10s                   transplant date
fudate          str10  %10s                   end of follow-up
fustat          byte   %8.0g                  dead or alive
surgery         byte   %8.0g                  prior bypass surgery
age             float  %9.0g                  age (in days)
futime          int    %8.0g                  follow-up time
transplant      byte   %8.0g                  transplant indicator
-------------------------------------------------------------------------------
```

2. **Date**: Look at *dates* recorded as string and generate corresponding variables in date format (Stata calculates the number of days between date of interest and 1/1/1960)

```
. gen birth_date=date(birthdt,"YMD")
. list birthdt birth_date if _n==1
     +----------------------+
     |    birthdt   birth_~e |
     |----------------------|
  1. | 1937-01-10      -8391 |
     +----------------------+
. gen accept_date=date(acceptdt,"YMD")
. list acceptdt accept_date if _n==1
     +----------------------+
     |   acceptdt   accept~e |
     |----------------------|
  1. | 1967-11-15       2875 |
```

```
     +----------------------+
. gen fu_date=date(fudate,"YMD")
. list fudate fu_date if _n==1
     +----------------------+
     |     fudate   fu_date |
     |----------------------|
  1. | 1968-01-03      2924 |
     +----------------------+
. replace txdate="" if txdate=="NA"
(34 real changes made)
. gen tx_date=date(txdate,"YMD")
(34 missing values generated)
. list txdate tx_date if _n==1
     +------------------+
     | txdate   tx_date |
     |------------------|
  1. |                . |
     +------------------+
. format birth_date accept_date fu_date tx_date %d
. list birth_date accept_date fu_date tx_date if _n==1
     +-------------------------------------------+
     | birth_d~e   accept_~e     fu_date   tx_date |
     |-------------------------------------------|
  1. | 10jan1937   15nov1967   03jan1968         . |
     +-------------------------------------------+
. drop birthdt acceptdt txdate fudate
```

3. **Time-scales**: Define different time-scales according to available information

```
. stset futime,fail(fustat)id(id)
------------------------------------------------------------------------------
      103  total obs.
        1  obs. end on or before enter()
------------------------------------------------------------------------------
      102  obs. remaining, representing
      102  subjects
       74  failures in single failure-per-subject data
    31851  total analysis time at risk, at risk from t =         0
                              earliest observed entry t =         0
                                   last observed exit t =      1799

. list _st _d _t0 _t if _n<5

     +--------------------+
     | _st   _d   _t0   _t |
     |--------------------|
  1. |   1    1     0   49 |
  2. |   1    1     0    5 |
  3. |   1    1     0   15 |
```

```
  4. |   1    1     0   38 |
     +---------------------+

. stset fu_date,fail(fustat)enter(accept_date)origin(accept_date)id(id)

                id:  id
     failure event:  fustat != 0 & fustat < .
obs. time interval:  (fu_date[_n-1], fu_date]
 enter on or after:  time accept_date
 exit on or before:  failure
    t for analysis:  (time-origin)
            origin:  time accept_date

--------------------------------------------------------------------------------
      103  total obs.
        1  obs. end on or before enter()
--------------------------------------------------------------------------------
      102  obs. remaining, representing
      102  subjects
       74  failures in single failure-per-subject data
    31851  total analysis time at risk, at risk from t =         0
                              earliest observed entry t =         0
                                   last observed exit t =      1799

. list _st _d _t0 _t if _n<5

     +---------------------+
     | _st   _d   _t0   _t |
     |---------------------|
  1. |   1    1     0   49 |
  2. |   1    1     0    5 |
  3. |   1    1     0   15 |
  4. |   1    1     0   38 |
     +---------------------+

. stset fu_date,fail(fustat)enter(accept_date)origin(birth_date)id(id)

                id:  id
     failure event:  fustat != 0 & fustat < .
obs. time interval:  (fu_date[_n-1], fu_date]
 enter on or after:  time accept_date
 exit on or before:  failure
    t for analysis:  (time-origin)
            origin:  time birth_date

--------------------------------------------------------------------------------
      103  total obs.
        1  obs. end on or before enter()
--------------------------------------------------------------------------------
```

```
      102  obs. remaining, representing
      102  subjects
       74  failures in single failure-per-subject data
    31851  total analysis time at risk, at risk from t =         0
                             earliest observed entry t =      3209
                                  last observed exit t =     23601

. list _st _d _t0 _t if _n<5

     +--------------------------+
     | _st   _d     _t0      _t |
     |--------------------------|
  1. |   1    1   11266   11315 |
  2. |   1    1   18933   18938 |
  3. |   1    1   19832   19847 |
  4. |   1    1   14706   14744 |
     +--------------------------+

. stset fu_date,fail(fustat)enter(accept_date)origin(birth_date)id(id) scale(365.25)

                id:  id
     failure event:  fustat != 0 & fustat < .
obs. time interval:  (fu_date[_n-1], fu_date]
 enter on or after:  time accept_date
 exit on or before:  failure
    t for analysis:  (time-origin)/365.25
            origin:  time birth_date

--------------------------------------------------------------------------------
      103  total obs.
        1  obs. end on or before enter()
--------------------------------------------------------------------------------
      102  obs. remaining, representing
      102  subjects
       74  failures in single failure-per-subject data
 87.20329  total analysis time at risk, at risk from t =         0
                             earliest observed entry t =  8.785763
                                  last observed exit t =  64.61602

. list _st _d _t0 _t if _n<5

     +---------------------------------+
     | _st   _d         _t0         _t |
     |---------------------------------|
  1. |   1    1   30.844627   30.978782 |
  2. |   1    1   51.835729   51.849418 |
  3. |   1    1   54.297057   54.338125 |
  4. |   1    1   40.262834   40.366872 |
     +---------------------------------+
```

4. **Preliminary analysis** Describe data looking at frequency distribution of variables by transplant and interpret the results

```
. sum age,d

                        age (in days)
-------------------------------------------------------------
      Percentiles      Smallest
 1%     19.55099       8.785763
 5%     26.65024       19.55099
10%     30.53525       20.33128       Obs                 103
25%     41.11157       20.78576       Sum of Wgt.         103

50%     47.75085                      Mean           45.16943
                        Largest       Std. Dev.      9.795042
75%     52.08487       58.35729
90%     54.57358       59.12389       Variance       95.94285
95%     56.33128       61.50034       Skewness      -1.143924
99%     61.50034       64.40794       Kurtosis       4.497807

. ttest age,by(transplant)

Two-sample t test with equal variances
------------------------------------------------------------------------------
   Group |     Obs        Mean    Std. Err.   Std. Dev.   [95% Conf. Interval]
---------+--------------------------------------------------------------------
       0 |      34    43.41635    1.951569     11.3795    39.44586    47.38685
       1 |      69    46.03327     1.06851    8.875709    43.90109    48.16545
---------+--------------------------------------------------------------------
combined |     103    45.16943    .9651342    9.795042     43.2551    47.08377
---------+--------------------------------------------------------------------
    diff |           -2.616917    2.046027               -6.675684    1.441851
------------------------------------------------------------------------------
    diff = mean(0) - mean(1)                                      t =  -1.2790
Ho: diff = 0                                     degrees of freedom =      101

    Ha: diff < 0                 Ha: diff != 0                 Ha: diff > 0
 Pr(T < t) = 0.1019         Pr(|T| > |t|) = 0.2038          Pr(T > t) = 0.8981

. egen age_cat=cut(age),at(0,41,48,52,100)

. tab age_cat

    age_cat |      Freq.     Percent        Cum.
------------+-----------------------------------
          0 |         25       24.27       24.27
         41 |         31       30.10       54.37
         48 |         20       19.42       73.79
```

```
         52 |          27       26.21      100.00
------------+-----------------------------------
      Total |         103      100.00

. tab age_cat transplant,col row chi2

           | transplant indicator
   age_cat |         0          1 |     Total
-----------+----------------------+----------
         0 |        10         15 |        25
           |     40.00      60.00 |    100.00
           |     29.41      21.74 |     24.27
-----------+----------------------+----------
        41 |        11         20 |        31
           |     35.48      64.52 |    100.00
           |     32.35      28.99 |     30.10
-----------+----------------------+----------
        48 |         4         16 |        20
           |     20.00      80.00 |    100.00
           |     11.76      23.19 |     19.42
-----------+----------------------+----------
        52 |         9         18 |        27
           |     33.33      66.67 |    100.00
           |     26.47      26.09 |     26.21
-----------+----------------------+----------
     Total |        34         69 |       103
           |     33.01      66.99 |    100.00
           |    100.00     100.00 |    100.00

          Pearson chi2(3) =   2.1703   Pr = 0.538

. tab surgery transplant,col row chi2

     prior |
    bypass | transplant indicator
   surgery |         0          1 |     Total
-----------+----------------------+----------
         0 |        31         56 |        87
           |     35.63      64.37 |    100.00
           |     91.18      81.16 |     84.47
-----------+----------------------+----------
         1 |         3         13 |        16
           |     18.75      81.25 |    100.00
           |      8.82      18.84 |     15.53
-----------+----------------------+----------
     Total |        34         69 |       103
           |     33.01      66.99 |    100.00
           |    100.00     100.00 |    100.00
```

```
          Pearson chi2(1) =   1.7418   Pr = 0.187

. tab age_cat fustat,col row chi2

           |     dead or alive
   age_cat |         0          1 |     Total
-----------+----------------------+----------
         0 |        13         12 |        25
           |     52.00      48.00 |    100.00
           |     46.43      16.00 |     24.27
-----------+----------------------+----------
        41 |         7         24 |        31
           |     22.58      77.42 |    100.00
           |     25.00      32.00 |     30.10
-----------+----------------------+----------
        48 |         5         15 |        20
           |     25.00      75.00 |    100.00
           |     17.86      20.00 |     19.42
-----------+----------------------+----------
        52 |         3         24 |        27
           |     11.11      88.89 |    100.00
           |     10.71      32.00 |     26.21
-----------+----------------------+----------
     Total |        28         75 |       103
           |     27.18      72.82 |    100.00
           |    100.00     100.00 |    100.00

          Pearson chi2(3) =  11.6817   Pr = 0.009

. tab surgery fustat,col row chi2

     prior |
    bypass |     dead or alive
   surgery |         0          1 |     Total
-----------+----------------------+----------
         0 |        21         66 |        87
           |     24.14      75.86 |    100.00
           |     75.00      88.00 |     84.47
-----------+----------------------+----------
         1 |         7          9 |        16
           |     43.75      56.25 |    100.00
           |     25.00      12.00 |     15.53
-----------+----------------------+----------
     Total |        28         75 |       103
           |     27.18      72.82 |    100.00
           |    100.00     100.00 |    100.00

          Pearson chi2(1) =   2.6261   Pr = 0.105
```

```
. tab  transplant fustat,col row chi2

transplant |     dead or alive
 indicator |         0          1 |     Total
-----------+----------------------+----------
         0 |         4         30 |        34
           |     11.76      88.24 |    100.00
           |     14.29      40.00 |     33.01
-----------+----------------------+----------
         1 |        24         45 |        69
           |     34.78      65.22 |    100.00
           |     85.71      60.00 |     66.99
-----------+----------------------+----------
     Total |        28         75 |       103
           |     27.18      72.82 |    100.00
           |    100.00     100.00 |    100.00

          Pearson chi2(1) =   6.0965   Pr = 0.014
```

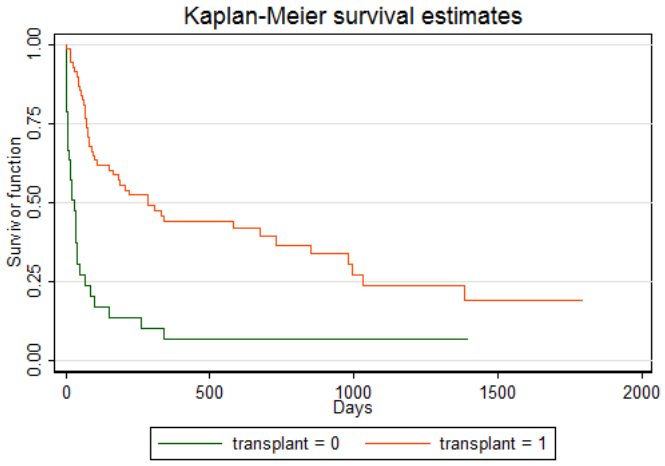
5. **Survival analysis** Declare data to be survival-data in order to take into account the follow-up

```
. stset futime,fail(fustat)id(id)

                id:  id
     failure event:  fustat != 0 & fustat < .
obs. time interval:  (futime[_n-1], futime]
 exit on or before:  failure

--------------------------------------------------------------------------------
      103  total obs.
        1  obs. end on or before enter()
--------------------------------------------------------------------------------
      102  obs. remaining, representing
      102  subjects
       74  failures in single failure-per-subject data
    31851  total analysis time at risk, at risk from t =         0
                             earliest observed entry t =         0
                                  last observed exit t =      1799
```

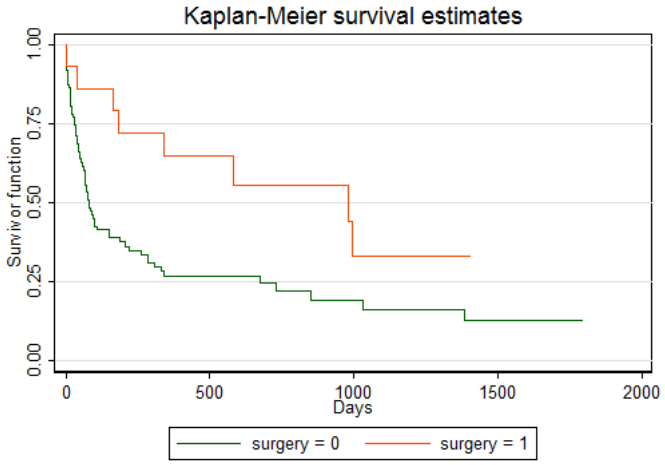
6. By using non-parametric methods represent the survival curves by Kaplan-Meier estimator and test their difference by transpant, surgery and age

```
. sts graph,by(transplant) xtitle("Days") ytitle("Survivor function")
. sts test transplant

Log-rank test for equality of survivor functions

           |   Events         Events
```

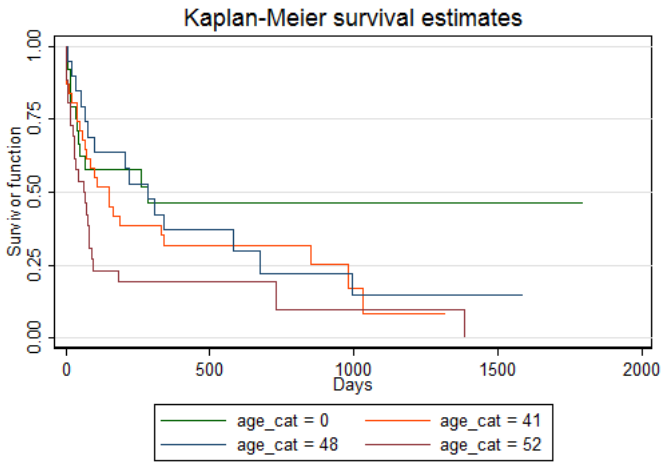
```
transplant |  observed       expected
-----------+-------------------------
0          |        29          11.76
1          |        45          62.24
-----------+-------------------------
Total      |        74          74.00

                  chi2(1) =      31.52
                  Pr>chi2 =     0.0000
```




```
. sts graph,by(surgery) xtitle("Days") ytitle("Survivor function")
. sts test surgery

Log-rank test for equality of survivor functions

        |   Events         Events
surgery |  observed       expected
--------+-------------------------
0       |        66          57.74
1       |         8          16.26
--------+-------------------------
Total   |        74          74.00

              chi2(1) =       5.57
              Pr>chi2 =     0.0182

. sts graph,by(age_cat) xtitle("Days") ytitle("Survivor function")
. sts test age_cat

Log-rank test for equality of survivor functions

        |   Events         Events
```




```
age_cat |  observed       expected
--------+-------------------------
0       |        12          19.14
41      |        24          23.37
48      |        15          17.66
52      |        23          13.83
--------+-------------------------
Total   |        74          74.00

          chi2(3) =       9.39
          Pr>chi2 =     0.0245
```



7. Calculate the rates by transplant, surgery and age by assuming constant hazard

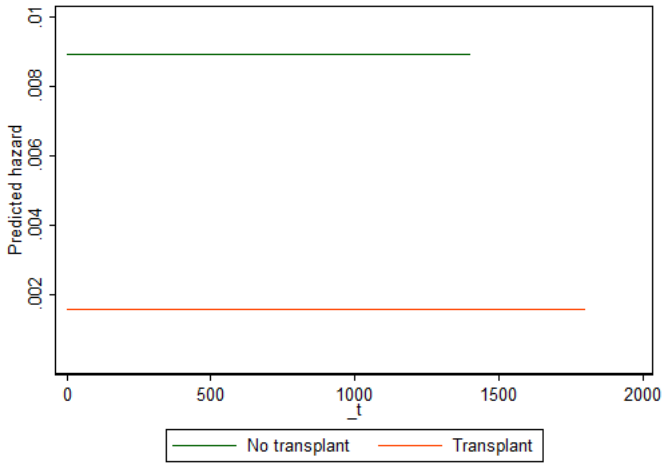
```
. strate surgery,per(1000)
```

```
Estimated rates (per 1000) and lower/upper bounds of 95% confidence intervals
(102 records included in the analysis)

  +-------------------------------------------------------+
  | surgery    D         Y      Rate     Lower     Upper |
  |-------------------------------------------------------|
  |       0   66   22.7160   2.90544   2.28263   3.69818 |
  |       1    8    9.1350   0.87575   0.43796   1.75116 |
  +-------------------------------------------------------+

. strate age_cat,per(1000)

Estimated rates (per 1000) and lower/upper bounds of 95% confidence intervals
(102 records included in the analysis)

  +-------------------------------------------------------+
  | age_cat    D         Y      Rate     Lower     Upper |
  |-------------------------------------------------------|
  |       0   12   10.0150   1.19820   0.68047   2.10985 |
  |      41   24    9.4510   2.53941   1.70209   3.78865 |
  |      48   15    7.8960   1.89970   1.14526   3.15111 |
  |      52   23    4.4890   5.12364   3.40479   7.71021 |
  +-------------------------------------------------------+


. strate transplant,per(1000)

Estimated rates (per 1000) and lower/upper bounds of 95% confidence intervals
(102 records included in the analysis)

  +-------------------------------------------------------+
  | transp~t    D         Y     Rate    Lower     Upper |
  |-------------------------------------------------------|
  |        0   29    3.2530   8.9148   6.1951   12.8286 |
  |        1   45   28.5980   1.5735   1.1749    2.1075 |
  +-------------------------------------------------------+

. di  1.5735/8.9148
.17650424
```

8. Estimate the crude effect of transplant on death by the exponential model(remember the underlying assumption of constant hazard)

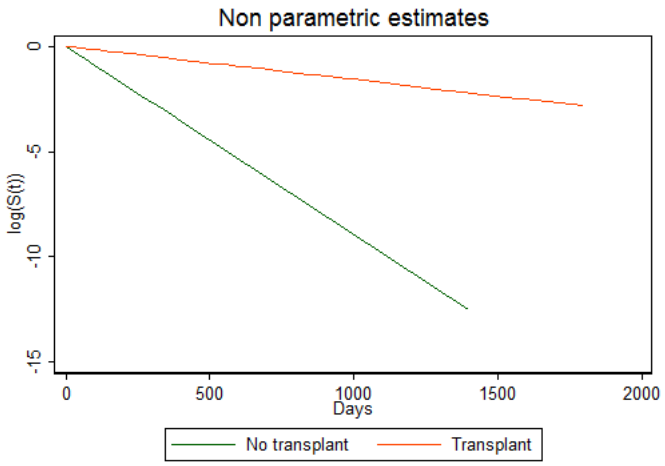
```
. xi:streg i.transplant,dist(e)nohr

Exponential regression -- log relative-hazard form

No. of subjects =          102                     Number of obs   =       102
No. of failures =           74
Time at risk    =        31851
```

```
                                                LR chi2(1)      =      42.92
Log likelihood  =   -207.31163                  Prob > chi2     =     0.0000

------------------------------------------------------------------------------
          _t |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_Itranspla~1 |  -1.734392   .2381281    -7.28   0.000    -2.201115    -1.26767
       _cons |  -4.720037   .1856953   -25.42   0.000    -5.083993   -4.356081
------------------------------------------------------------------------------

. di exp(_b[_Itransplan_1]+_b[_cons])/exp(_b[_cons])
.1765074

. xi:streg i.transplant,dist(e)

Exponential regression -- log relative-hazard form

No. of subjects =          102                  Number of obs   =       102
No. of failures =           74
Time at risk    =        31851
                                                LR chi2(1)      =      42.92
Log likelihood  =   -207.31163                  Prob > chi2     =     0.0000

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_Itranspla~1 |   .1765074   .0420314    -7.28   0.000     .1106797    .2814867
------------------------------------------------------------------------------

. predict hazard_exp,hazard
. twoway (line hazard _t if transplant==0)(line hazard _t if transplant==1), ///
> yscale(range(0 0.01))legend (lab(1 "No transplant")lab(2 "Transplant"))
```



9. Check the goodness of fit of the exponential model by non-parametric method

```
. predict surv_exp,surv
. gen logkm=log(surv)
. twoway (line logkm _t if transplant==0,sort)(line logkm _t if transplant==1,sort), ///
> legend(lab(1 "No transplant") lab(2 "Transplant")) ytitle("log(S(t))") ///
xtitle("Days") title("Non parametric estimates")
```



10. Estimate the adjusted effect of transplant on death by the exponential model (look at potential confounders and interactions between the variables included into the model (age and surgery))

```
. xi:streg i.transplant,dist(e)
Exponential regression -- log relative-hazard form

No. of subjects =          102                     Number of obs   =       102
No. of failures =           74
Time at risk    =        31851
                                                    LR chi2(1)      =     42.92
Log likelihood  =   -207.31163                      Prob > chi2     =    0.0000

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_Itranspla~1 |   .1765074   .0420314    -7.28   0.000     .1106797    .2814867
------------------------------------------------------------------------------

. est store a
. xi:streg i.transplant age,dist(e)
Exponential regression -- log relative-hazard form

No. of subjects =          102                     Number of obs   =       102
No. of failures =           74
Time at risk    =        31851
```

```
                                                  LR chi2(2)      =     82.83
Log likelihood  =    -187.3601                    Prob > chi2     =    0.0000

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_Itranspla~1 |   .0805737   .0205216    -9.89   0.000       .04891     .132736
         age |   1.095157   .0166249     5.99   0.000     1.063052     1.12823
------------------------------------------------------------------------------

. est store b
. lrtest a b

Likelihood-ratio test                                 LR chi2(1)  =     39.90
(Assumption: a nested in b)                           Prob > chi2 =    0.0000

. xi:streg i.transplant i.age_cat,dist(e)
Exponential regression -- log relative-hazard form

No. of subjects =          102                    Number of obs   =       102
No. of failures =           74
Time at risk    =        31851
                                                  LR chi2(4)      =     87.87
Log likelihood  =   -184.83636                    Prob > chi2     =    0.0000

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_Itranspla~1 |   .0812555   .0220401    -9.25   0.000     .0477495    .1382729
_Iage_cat_41 |   3.892869   1.402478     3.77   0.000      1.92136    7.887344
_Iage_cat_48 |   5.018092   2.141299     3.78   0.000      2.17429    11.58137
_Iage_cat_52 |   12.16446   4.712941     6.45   0.000     5.692561    25.99431
------------------------------------------------------------------------------

. est store c
. lrtest b c

Likelihood-ratio test                                 LR chi2(2)  =      5.05
(Assumption: b nested in c)                           Prob > chi2 =    0.0802

. xi:streg i.transplant age i.surgery,dist(e)

Exponential regression -- log relative-hazard form

No. of subjects =          102                    Number of obs   =       102
No. of failures =           74
Time at risk    =        31851
                                                  LR chi2(3)      =     86.89
Log likelihood  =   -185.32938                    Prob > chi2     =    0.0000
```

```
------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_Itranspla~1 |   .0965496   .0257619    -8.76   0.000     .0572305     .162882
         age |   1.091327   .0161911     5.89   0.000      1.06005    1.123527
 _Isurgery_1 |   .4831018   .1880169    -1.87   0.062     .2253005    1.035894
------------------------------------------------------------------------------

. xi:streg i.transplant*age i.surgery,dist(e)

Exponential regression -- log relative-hazard form

No. of subjects =          102                     Number of obs   =       102
No. of failures =           74
Time at risk    =        31851
                                                   LR chi2(4)      =     87.98
Log likelihood  =   -184.78111                     Prob > chi2     =    0.0000

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_Itranspla~1 |   .4180958   .5902384    -0.62   0.537      .026279    6.651854
         age |   1.105564   .0216405     5.13   0.000     1.063953    1.148803
 _ItraXage_1 |   .9691257   .0288526    -1.05   0.292      .914194    1.027358
 _Isurgery_1 |   .4637306   .1808109    -1.97   0.049     .2159623    .9957575
------------------------------------------------------------------------------

. testparm  _ItraXage_1
 ( 1)  [_t]_ItraXage_1 = 0

           chi2(  1) =    1.11
         Prob > chi2 =    0.2922

. xi:streg i.transplant*i.surgery age,dist(e)

Exponential regression -- log relative-hazard form

No. of subjects =          102                     Number of obs   =       102
No. of failures =           74
Time at risk    =        31851
                                                   LR chi2(4)      =     92.26
Log likelihood  =   -182.64147                     Prob > chi2     =    0.0000

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_Itranspla~1 |   .1083611   .0294098    -8.19   0.000      .063658    .1844565
 _Isurgery_1 |   4.042254   2.962277     1.91   0.057     .9612563     16.9984
```

```
_ItraXsur_~1 |   .0882042    .075407    -2.84   0.005     .0165115    .4711867
         age |   1.090235    .016343     5.76   0.000     1.058669    1.122742
------------------------------------------------------------------------------

. testparm  _ItraXsur_1_1

 ( 1)  [_t]_ItraXsur_1_1 = 0

           chi2(  1) =    8.07
         Prob > chi2 =    0.0045

. xi:streg i.transplant*i.surgery age,dist(e)nohr

Exponential regression -- log relative-hazard form

No. of subjects =          102                     Number of obs   =       102
No. of failures =           74
Time at risk    =        31851
                                                    LR chi2(4)      =     92.26
Log likelihood  =   -182.64147                      Prob > chi2     =    0.0000

------------------------------------------------------------------------------
          _t |      Coef.   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
_Itranspla~1 |  -2.222286   .2714051    -8.19   0.000     -2.75423   -1.690342
 _Isurgery_1 |   1.396802   .7328281     1.91   0.057    -.0395142    2.833119
_ItraXsur_~1 |  -2.428101   .8549137    -2.84   0.005    -4.103701   -.7525009
         age |   .0863932   .0149904     5.76   0.000     .0570126    .1157738
       _cons |  -8.072892   .6668564   -12.11   0.000    -9.379906   -6.765877
------------------------------------------------------------------------------

. di exp(_b[_Itransplan_1])
.10836111
. di exp(_b[ _Isurgery_1])
4.0422541
. di exp(_b[age])
1.0902349
. di exp(_b[_Itransplan_1]+_b[ _Isurgery_1]+_b[_ItraXsur_1_1])
.03863547
. di exp(_b[_Itransplan_1]+_b[ _Isurgery_1]+_b[_ItraXsur_1_1])
.03863547
. di exp(_b[_Itransplan_1])*exp(_b[_ItraXsur_1_1])
.0095579
. lincom _Itransplan_1+_ItraXsur_1_1,or

 ( 1)  [_t]_Itransplan_1 + [_t]_ItraXsur_1_1 = 0

------------------------------------------------------------------------------
          _t | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
```

```
------------+----------------------------------------------------------------
        (1) |   .0095579   .0078292    -5.68   0.000     .0019192    .0476002
------------------------------------------------------------------------------

. di exp(_b[_Isurgery_1])*exp(_b[_ItraXsur_1_1])
.35654372
. lincom _Isurgery_1+_ItraXsur_1_1,or

 ( 1)  [_t]_Isurgery_1 + [_t]_ItraXsur_1_1 = 0

------------------------------------------------------------------------------
          _t | Odds Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   .3565437   .1569728    -2.34   0.019     .1504391    .8450159
------------------------------------------------------------------------------
```

11. Now consider the transplant as time-dependent variable (at the beginning of study some patients were not transplanted and then they got transplanted during the follow-up and their status changed from no-transplanted to transplanted)

```
. stset fu_date,fail(fustat)enter(accept_date)origin(accept_date)id(id)

                id:  id
     failure event:  fustat != 0 & fustat < .
obs. time interval:  (fu_date[_n-1], fu_date]
 enter on or after:  time accept_date
 exit on or before:  failure
    t for analysis:  (time-origin)
            origin:  time accept_date

------------------------------------------------------------------------------
      103  total obs.
        1  obs. end on or before enter()
------------------------------------------------------------------------------
      102  obs. remaining, representing
      102  subjects
       74  failures in single failure-per-subject data
    31851  total analysis time at risk, at risk from t =         0
                              earliest observed entry t =         0
                                   last observed exit t =      1799

. list _st _d _t0 _t accept_date fu_date tx_date if id<10

     +-------------------------------------------------------------+
     | _st   _d   _t0    _t   accept_~e     fu_date     tx_date |
     |-------------------------------------------------------------|
  1. |   1    1     0    49   15nov1967   03jan1968           . |
  2. |   1    1     0     5   02jan1968   07jan1968           . |
  3. |   1    1     0    15   06jan1968   21jan1968   06jan1968 |
  4. |   1    1     0    38   28mar1968   05may1968   02may1968 |
```

```
  5. |   1    1     0    17   10may1968   27may1968           . |
     |-------------------------------------------------------------|
  6. |   1    1     0     2   13jun1968   15jun1968           . |
  7. |   1    1     0   674   12jul1968   17may1970   31aug1968 |
  8. |   1    1     0    39   01aug1968   09sep1968           . |
  9. |   1    1     0    84   09aug1968   01nov1968           . |
     +-------------------------------------------------------------+

. stsplit time=tx_date,at(0)
(66 observations (episodes) created)

. replace time=time+1
(168 real changes made)

. replace time=0 if transplant==0
(34 real changes made)

. list _st _d _t0 _t accept_date fu_date tx_date if id<10

     +-------------------------------------------------------------+
     | _st   _d   _t0    _t   accept_~e     fu_date     tx_date |
     |-------------------------------------------------------------|
  1. |   1    1     0    49   15nov1967   03jan1968           . |
  2. |   1    1     0     5   02jan1968   07jan1968           . |
  3. |   1    1     0    15   06jan1968   21jan1968   06jan1968 |
  4. |   1    0     0    35   28mar1968   02may1968   02may1968 |
  5. |   1    1    35    38   28mar1968   05may1968   02may1968 |
     |-------------------------------------------------------------|
  6. |   1    1     0    17   10may1968   27may1968           . |
  7. |   1    1     0     2   13jun1968   15jun1968           . |
  8. |   1    0     0    50   12jul1968   31aug1968   31aug1968 |
  9. |   1    1    50   674   12jul1968   17may1970   31aug1968 |
 10. |   1    1     0    39   01aug1968   09sep1968           . |
     |-------------------------------------------------------------|
 11. |   1    1     0    84   09aug1968   01nov1968           . |
     +-------------------------------------------------------------+

. xi:streg i.time,dist(e)

Exponential regression -- log relative-hazard form

No. of subjects =          102                     Number of obs   =       168
No. of failures =           74
Time at risk    =        31851
                                                   LR chi2(1)      =     19.59
Log likelihood  =   -218.97634                     Prob > chi2     =    0.0000

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
```

```
-------------+----------------------------------------------------------------
    _Itime_1 |   .3301946   .0781806    -4.68   0.000     .2076012    .5251821
------------------------------------------------------------------------------

. xi:streg i.time age,dist(e)

Exponential regression -- log relative-hazard form

No. of subjects =          102                     Number of obs   =       168
No. of failures =           74
Time at risk    =        31851
                                                    LR chi2(2)      =     36.50
Log likelihood  =   -210.52516                      Prob > chi2     =    0.0000

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    _Itime_1 |   .2658755   .0636053    -5.54   0.000     .1663588    .4249235
         age |   1.059868   .0160806     3.83   0.000     1.028815    1.091859
------------------------------------------------------------------------------

. xi:streg i.time i.surgery age,dist(e)

Exponential regression -- log relative-hazard form

No. of subjects =          102                     Number of obs   =       168
No. of failures =           74
Time at risk    =        31851
                                                    LR chi2(3)      =     46.43
Log likelihood  =   -205.55801                      Prob > chi2     =    0.0000

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
    _Itime_1 |   .3056097    .074142    -4.89   0.000     .1899602    .4916677
 _Isurgery_1 |   .3501797   .1323913    -2.78   0.006     .1669091    .7346864
         age |   1.058788   .0151877     3.98   0.000     1.029435    1.088978
------------------------------------------------------------------------------

. xi:streg i.time*i.surgery age,dist(e)

Exponential regression -- log relative-hazard form

No. of subjects =          102                     Number of obs   =       168
No. of failures =           74
Time at risk    =        31851
                                                    LR chi2(4)      =     46.51
Log likelihood  =   -205.51903                      Prob > chi2     =    0.0000
```

_t	Haz. Ratio	Std. Err.	z	P>|z|	[95% Conf.	Interval]
_Itime_1	.3119189	.0790243	-4.60	0.000	.1898414	.5124985
_Isurgery_1	.420622	.3083742	-1.18	0.238	.099964	1.769867
ItimXsur~1	.7841233	.671246	-0.28	0.776	.1464591	4.198096
age	1.05848	.0152208	3.95	0.000	1.029065	1.088737