Stata commands for survival analysis

Aims of a Survival Analysis

- Summarize the distribution of survival times

  Tool: Kaplan-Meier estimates (of survival distribution)
- Compare survival distributions between groups

  Tool: logrank test
- Investigate predictors of survival

  Tool: Cox regression model

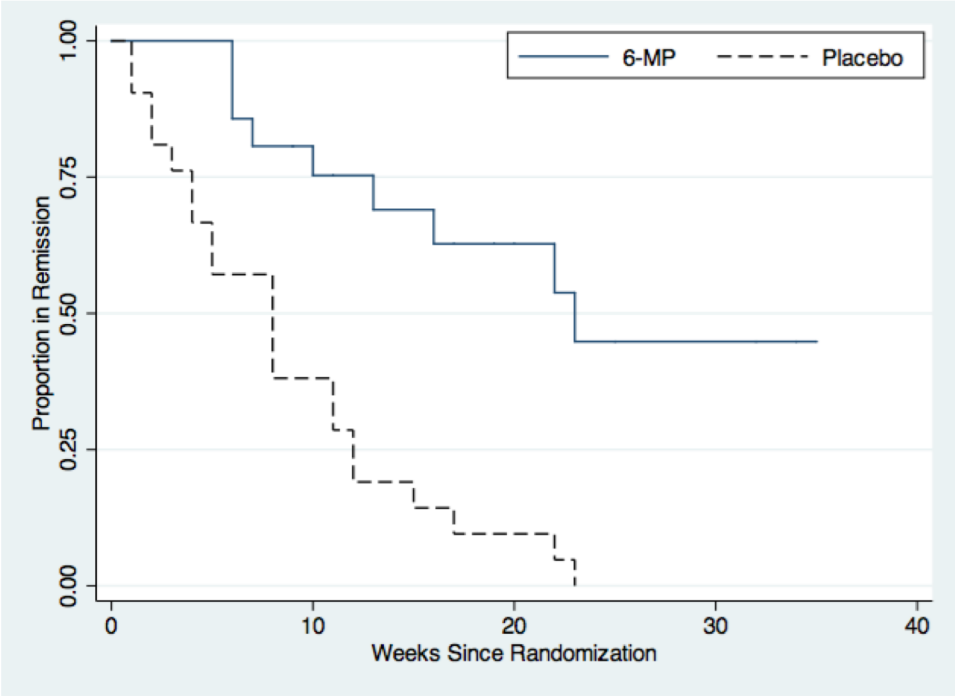
Declare survival data

```
use leuk.dta
stset time, f(cens)


     failure event:  cens != 0 & cens < .
obs. time interval:  (0, time]
 exit on or before:  failure

--------------------------------------------------------------------------
       42  total observations
        0  exclusions
--------------------------------------------------------------------------
       42  observations remaining, representing
       30  failures in single-record/single-failure data
      541  total analysis time at risk and under observation
                                             at risk from t =         0
                                  earliest observed entry t =         0
                                       last observed exit t =        35
```

Kaplan-Meier Estimates

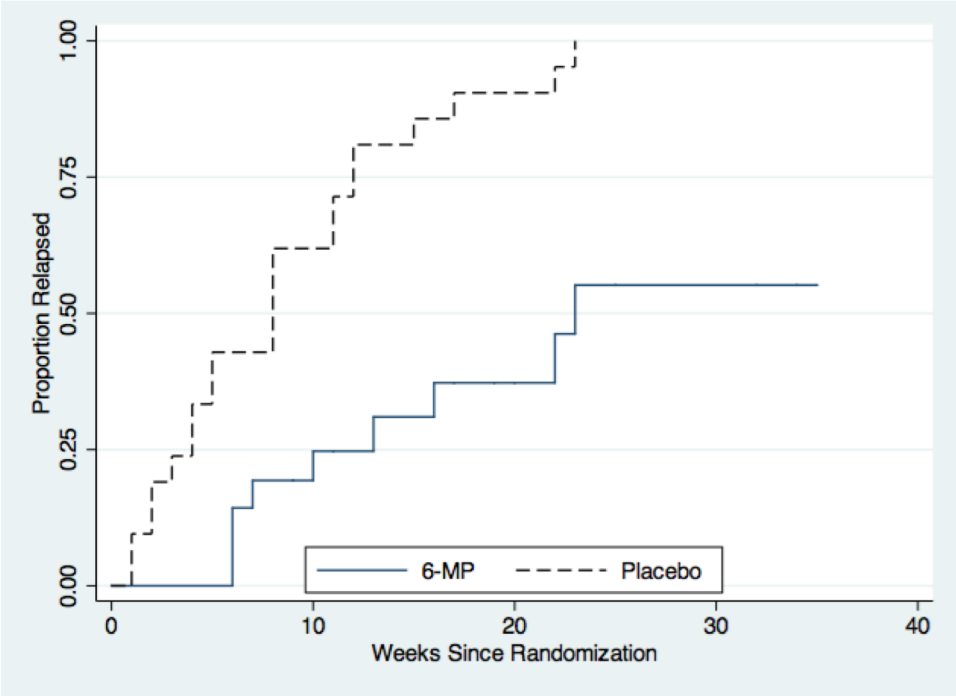
K-M Survival function

```
sts graph, by(group)
```



Cumulative relapse incidence

```
sts graph, by(group) failure
```



Median Survival Time

stci, by(group)

```
         failure _d:  cens
   analysis time _t:  time

             |    no. of
group        |  subjects         50%     Std. Err.     [95% Conf. Interval]
-------------+-------------------------------------------------------------
     placebo |        21           8      1.669046            4           11
        6-MP |        21          23      2.252304           13            .
-------------+-------------------------------------------------------------
       total |        42          12      1.716577            8           17
```

Logrank test for ALL data

```
sts test group

         failure _d:  cens
   analysis time _t:  time


Log-rank test for equality of survivor functions

         |   Events          Events
group    |  observed        expected
---------+-------------------------
6 MP     |         9           19.25
Placebo  |        21           10.75
---------+-------------------------
Total    |        30           30.00

               chi2(1) =      16.79
               Pr>chi2 =     0.0000
```

Cox Regression

```
stcox group, nolog
```

"Group" coded 0/1
0 = placebo;
1 = 6-MP

```
        failure _d:  cens
  analysis time _t:  time

Cox regression -- Breslow method for ties

No. of subjects =         42                 Number of obs    =        42
No. of failures =         30
Time at risk    =        541

                                             LR chi2(1)       =     15.21
Log likelihood  =   -86.379622               Prob > chi2      =    0.0001

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |   .2210887   .0905501    -3.68   0.000     .0990706    .4933877
------------------------------------------------------------------------------
```

Cox Regression

```
stcox group, nolog

        failure _d:  cens
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Cox regression -- Breslow method for ties

No. of subjects =         42                     Number of obs    =        42
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------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |   .2210887   .0905501    -3.68   0.000     .0990706    .4933877
------------------------------------------------------------------------------
```

Estimated hazard ratio = 0.22 (6-MP vs placebo)

Cox Regression

```
stcox group, nolog

         failure _d:  cens
   analysis time _t:  time

Cox regression -- Breslow method for ties

No. of subjects =           42                     Number of obs    =        42
No. of failures =           30
Time at risk    =          541
                                                   LR chi2(1)       =     15.21
Log likelihood  =   -86.379622                     Prob > chi2      =    0.0001

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |   .2210887   .0905501    -3.68   0.000     .0990706    .4933877
------------------------------------------------------------------------------
```

95% CI of HR

Cox Regression

```
stcox group, nolog

         failure _d:  cens
   analysis time _t:  time

Cox regression -- Breslow method for ties

No. of subjects =           42                     Number of obs    =        42
No. of failures =           30
Time at risk    =          541
                                                   LR chi2(1)       =     15.21
Log likelihood  =   -86.379622                     Prob > chi2      =    0.0001

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
       group |   .2210887   .0905501    -3.68   0.000     .0990706    .4933877
------------------------------------------------------------------------------
```

Wald test p-value < 0.05 for testing $\beta = 0$;
group hazards are statistically significantly different

Two useful post-estimation commands

- **`lincom`** — linear combinations of estimators

placebo vs 6-MP

	group
placebo	0
6-MP	1
diff	-1

Two useful post-estimation commands

- **`lincom`** — linear combinations of estimators

```
lincom -1*group, hr

 ( 1)  - group = 0

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   4.523072   1.852489     3.68   0.000     2.026804    10.09382
------------------------------------------------------------------------------
```

Estimated hazard ratio = 4.52 (placebo vs 6-MP)

Two useful post-estimation commands

- **`lincom`** — linear combinations of estimators

```
lincom -1*group, hr

 ( 1)  - group = 0

------------------------------------------------------------------------------
          _t | Haz. Ratio   Std. Err.      z    P>|z|     [95% Conf. Interval]
-------------+----------------------------------------------------------------
         (1) |   4.523072   1.852489     3.68   0.000     2.026804    10.09382
------------------------------------------------------------------------------
```

Estimated hazard ratio = 4.52 (placebo vs 6-MP)

- **`contrast`** — contrasts and linear hypothesis tests

  more in the next lecture