

stcurve — Plot the survivor or related function after `streg`, `stcox`, and others

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Description

`stcurve` plots the survivor, failure, hazard, or cumulative hazard function after `stcox`, `streg`, `stintreg`, `mestreg`, or `xtstreg`. `stcurve` also plots the cumulative subhazard or cumulative incidence function (CIF) after `stcrreg`.

Quick start

Plot the survivor function with covariates at their means after `stcox`, `streg`, `stintreg`, `mestreg`, or `xtstreg`

```
stcurve, survival
```

As above, but plot separate survivor functions for covariate `x` set to 1, 2, and 3

```
stcurve, survival at1(x=1) at2(x=2) at3(x=3)
```

As above, but specify a numlist for `x` in `at()`

```
stcurve, survival at(x=(1 2 3))
```

As above, but specify a different pattern for each line

```
stcurve, survival at(x=(1 2 3)) lpattern(solid dash dot)
```

As above, and save the graph as `mygraph.gph`

```
stcurve, survival at(x=(1 2 3)) saving(mygraph)
```

Plot the estimated hazard function after `stcox`, `streg`, `stintreg`, `mestreg`, or `xtstreg`

```
stcurve, hazard
```

Smooth the estimated hazard contributions using the Gaussian kernel function for the kernel-density estimate after `stcox`, and set `x` to 1

```
stcurve, hazard kernel(gaussian) at(x=1)
```

Plot the cumulative hazard function after `stcox`, `streg`, `stintreg`, `mestreg`, or `xtstreg`

```
stcurve, cumhaz
```

Plot the cumulative subhazard function after `stcrreg`

```
stcurve, cumhaz
```

Plot the cumulative incidence function after `stcrreg`

```
stcurve, cif
```

As above, but set `x` to 0

```
stcurve, cif at(x=0)
```

Menu

Statistics > Survival analysis > Regression models > Plot survivor or related function

Syntax

```
stcurve [ , options ]
```

options

Description

Main

* survival	plot survivor function
* failure	plot failure function
* hazard	plot hazard function
* cumhaz	plot cumulative hazard function
* cif	plot cumulative incidence function
at (<i>atspec</i>)	values of the specified covariates and means of
[at1 (<i>atspec1</i>) [at2 (<i>atspec2</i>) [...]]]	unspecified covariates

Options

alpha1	conditional frailty model
fixedonly	set all random effects to zero
unconditional	unconditional frailty model or random-effects model
marginal	synonym for unconditional
range (# #)	range of analysis time
outfile (<i>filename</i> [, replace])	save values used to plot the curves
width (#)	override “optimal” width; use with hazard
kernel (<i>kernel</i>)	kernel function; use with hazard
noboundary	no boundary correction; use with hazard

Plot

connect_options	affect rendition of plotted survivor, failure, hazard, or cumulative hazard function
------------------------	--

Add plots

addplot (<i>plot</i>)	add other plots to the generated graph
--------------------------------	--

Y axis, X axis, Titles, Legend, Overall

twoway_options	any options other than by () documented in [G-3] twoway_options
-----------------------	---

*One of **survival**, **failure**, **hazard**, **cumhaz**, or **cif** must be specified.

survival, **failure**, and **hazard** are not allowed after estimation with **stcrreg**; see [ST] **stcrreg**.

cif is allowed only after estimation with **stcrreg**; see [ST] **stcrreg**.

Options

Main

survival specifies that the survivor function be plotted. **survival** is not allowed after estimation with **stcrreg**.

`failure` specifies that the failure function be plotted. `failure` is not allowed after estimation with `stcrreg`.

`hazard` specifies that the hazard function be plotted. `hazard` is not allowed after estimation with `stcrreg`.

`cumhaz` specifies that the cumulative hazard function be plotted when used after `stcox`, `streg`, `stintreg`, `mestreg`, or `xtstreg` and specifies that the cumulative subhazard function be plotted when used after `stcrreg`.

`cif` specifies that the cumulative incidence function be plotted. This option is available only after estimation with `stcrreg`.

`at(atspec)` specifies that the estimates of the survivor or other function be evaluated at specific covariate values. By default, `stcurve` evaluates the function by setting each covariate to its mean value. This option causes the function to be evaluated at the values of the covariates listed in `at()` and at the means of all unlisted covariates. This option can be repeated to produce multiple curves, or you can specify multiple values for a set of covariates in one `at()` option; see [Syntax of at\(\)](#) in [\[ST\] adjustfor_option](#) for details. `at()` may not be combined with `at1()`, `at2()`, and so on.

`at1(atspec1)`, `at2(atspec2)`, ..., `at20(atspec20)` are the alternatives to the repeated use of `at()`. They specify that multiple curves (up to 20) be plotted on the same graph. `at1()`, `at2()`, ..., `at20()` work similarly to the `at()` option. They specify that the function be evaluated at the value of the specified covariates and at the mean of all unlisted covariates. `at1()` specifies the values of the covariates for the first curve, `at2()` specifies the values of the covariates for the second curve, and so on. But, unlike `at()`, `at#()` cannot be repeated and may not be combined with `at()`. `atspec1`, `atspec2`, and so on follow the same syntax as `atspec`, except they do not allow `numlists` or multiple values for the same covariate.

Options

`alpha1`, when used after fitting a frailty model, plots curves that are conditional on a frailty value of one. This is the default for shared-frailty models.

`fixedonly` specifies that all random effects be set to zero, which is equivalent to using only the fixed portion of the model, when plotting results for random-effects models. This option is allowed only after `xtstreg` or `mestreg`; it is the default after `xtstreg`.

`unconditional` and `marginal`, when used after fitting a frailty model or a random-effects model, plot curves that are unconditional on the frailty or on the random effects. That is, the curve is “averaged” over the frailty distribution or over the random-effects distributions. This is the default for unshared-frailty models and for random-effects models. This option is not allowed after `stintreg` or `xtstreg`.

`range(##)` specifies the range of the time axis to be plotted. If this option is not specified, `stcurve` plots the desired curve on an interval expanding from the earliest to the latest time in the data.

`outfile(filename [, replace])` saves in `filename.dta` the values used to plot the curve(s).

`width(#)` is for use with `hazard` (and applies only after `stcox`) and is used to specify the bandwidth to be used in the kernel smooth used to plot the estimated hazard function. If left unspecified, a default bandwidth is used, as described in [\[R\] kdensity](#).

`kernel(kernel)` is for use with `hazard` and is for use only after `stcox` because, for Cox regression, an estimate of the hazard function is obtained by smoothing the estimated *hazard contributions*. `kernel()` specifies the kernel function for use in calculating the weighted kernel-density estimate required to produce a smoothed hazard-function estimator. The default is `kernel(epanechnikov)`, yet `kernel` may be any of the kernels supported by `kdensity`; see [\[R\] kdensity](#).

`noboundary` is for use with `hazard` and applies only to the plotting of smoothed hazard functions after `stcox`. It specifies that no boundary-bias adjustments are to be made when calculating the smoothed hazard-function estimator. By default, the smoothed hazards are adjusted near the boundaries; see [ST] [sts graph](#). If the `epan2`, `biweight`, or `rectangular` kernel is used, the bias correction near the boundary is performed using boundary kernels. For other kernels, the plotted range of the smoothed hazard function is restricted to be inside of one bandwidth from each endpoint. For these other kernels, specifying `noboundary` merely removes this range restriction.

Plot

`connect_options` affect the rendition of the plotted survivor, failure, hazard, or cumulative hazard function; see [G-3] [connect_options](#).

Add plots

`addplot(plot)` provides a way to add other plots to the generated graph; see [G-3] [addplot_option](#).

Y axis, X axis, Titles, Legend, Overall

`tway_options` are any of the options documented in [G-3] [tway_options](#), excluding `by()`. These include options for titling the graph (see [G-3] [title_options](#)) and for saving the graph to disk (see [G-3] [saving_option](#)).

Remarks and examples

[stata.com](http://www.stata.com)

Remarks are presented under the following headings:

- [stcurve after stcox](#)
- [stcurve after streg](#)
- [stcurve after stcrreg](#)
- [stcurve after stintreg](#)
- [Using at\(\) with stcurve](#)

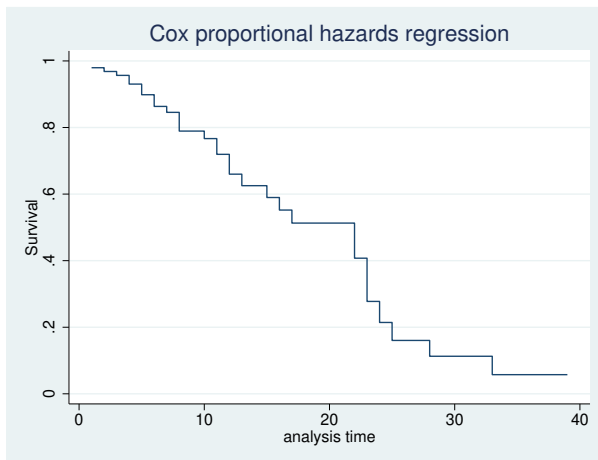
For examples of `stcurve` after `xtstreg` and `mestreg`, see [XT] [xtstreg postestimation](#) and [ME] [mestreg postestimation](#), respectively.

stcurve after stcox

After fitting a Cox model, `stcurve` can be used to plot the estimated survivor, failure, hazard, or cumulative hazard function.

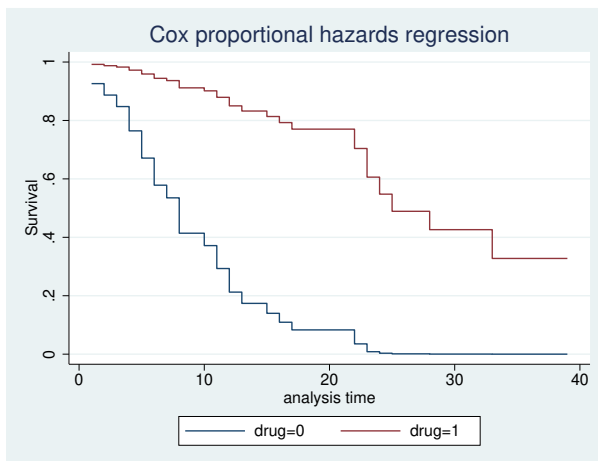
▷ Example 1

```
. use https://www.stata-press.com/data/r16/drugtr
(Patient Survival in Drug Trial)
. stcox age drug
(output omitted)
. stcurve, survival
```



By default, the curve is evaluated at the mean values of all the predictors, but we can specify other values if we wish.

```
. stcurve, survival at1(drug=0) at2(drug=1)
```



Alternatively, you can obtain the same plot by typing the following:

```
. stcurve, survival at(drug=(0 1))
```

In this example, we asked for two plots, one for the placebo group and one for the treatment group. For both groups, the value of `age` was held at its mean value for the overall estimation sample.

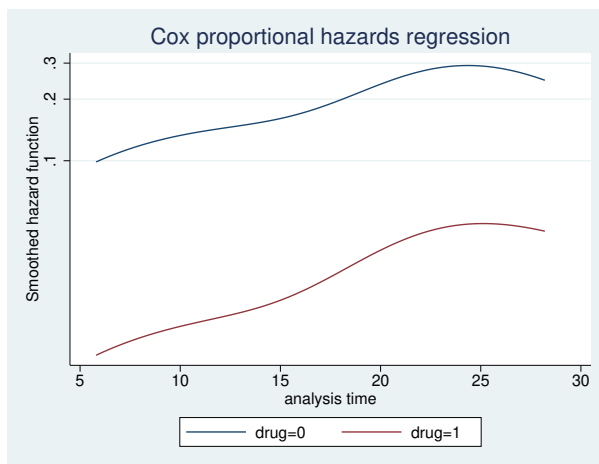
See [Cefalu \(2011\)](#) for a Stata command to plot the survivor or cumulative hazard function with pointwise confidence intervals.

◀

▶ Example 2

`stcurve` can also be used to plot estimated hazard functions. The hazard function is estimated by a kernel smooth of the estimated hazard contributions; see [\[ST\] sts graph](#) for details. We can thus customize the smooth as we would any other; see [\[R\] kdensity](#) for details.

```
. stcurve, hazard at(drug=(0 1)) kernel(gauss) yscale(log)
```



For the hazard plot, we plotted on a log scale to demonstrate the proportionality of hazards under this model; see the technical note below on smoothed hazards.

◀

□ Technical note

For survivor or cumulative hazard estimation, `stcurve` works by first estimating the baseline function and then modifying it to adhere to the specified (or by default, mean) covariate patterns. As mentioned previously, *baseline* (when all covariates are equal to zero) must correspond to something that is meaningful and preferably in the range of your data. Otherwise, `stcurve` could encounter numerical difficulties. We ignored our own advice above and left `age` unchanged. Had we encountered numerical problems, or funny-looking graphs, we would have known to try shifting `age` so that `age==0` was in the range of our data.

For hazard estimation, `stcurve` works by first transforming the estimated hazard contributions to adhere to the necessary covariate pattern and then applying the smooth. When you plot multiple curves, each is smoothed independently, although the same bandwidth is used for each.

The smoothing takes place in the hazard scale and not in the log hazard-scale. As a result, the resulting curves will look nearly, but not exactly, parallel when plotted on a log scale. This inexactitude is a product of the smoothing and should not be interpreted as a deviation from the proportional-hazards assumption; `stcurve` (after `stcox`) assumes proportionality of hazards and will reflect this in the

produced plots. If smoothing were a perfect science, the curves would be parallel when plotted on a log scale. If you encounter estimated hazards exhibiting severe disproportionality, this may signal a numerical problem as described above. Try recentering your covariates so that baseline is more reasonable.

□

stcurve after streg

`stcurve` is used after `streg` to plot the fitted survivor, failure, hazard, or cumulative hazard function. By default, `stcurve` computes the means of the covariates and evaluates the functions at each time in the data, censored or uncensored. The resulting plot is therefore the survival experience of a subject with a covariate pattern equal to the average covariate pattern in the study. You can produce the plot at other values of the covariates by using the `at()` option or specify a time range by using the `range()` option.

► Example 3

We pick up where [example 6](#) of [\[ST\] streg](#) left off. The cancer dataset we are using has three values for variable `drug`: 1 corresponds to placebo, and 2 and 3 correspond to two alternative treatments. Using the cancer data with `drug` remapped to form an indicator of treatment, let's fit a loglogistic regression model and plot its survival curves. We can perform a loglogistic regression by issuing the following commands:

```
. use https://www.stata-press.com/data/r16/cancer
(Patient Survival in Drug Trial)
. replace drug = drug==2 | drug==3           // 0, placebo : 1, nonplacebo
(48 real changes made)
. stset studytime, failure(died)
(output omitted)
. streg age drug, distribution(llogistic) nolog
      failure _d: died
      analysis time _t: studytime
Loglogistic AFT regression
No. of subjects =           48                Number of obs   =           48
No. of failures =           31
Time at risk    =           744
Log likelihood  =    -43.21698                LR chi2(2)       =           35.14
                                                Prob > chi2      =           0.0000
```

_t	Coef.	Std. Err.	z	P> z	[95% Conf. Interval]	
age	-.0803289	.0221598	-3.62	0.000	-.1237614	-.0368964
drug	1.420237	.2502148	5.68	0.000	.9298251	1.910649
_cons	6.446711	1.231914	5.23	0.000	4.032204	8.861218
/lgamma	-.8456552	.1479337	-5.72	0.000	-1.1356	-.5557105
gamma	.429276	.0635044			.3212293	.5736646

Now, we wish to plot the survivor and the hazard functions:

```
. stcurve, survival ylabel(0 .5 1)
```

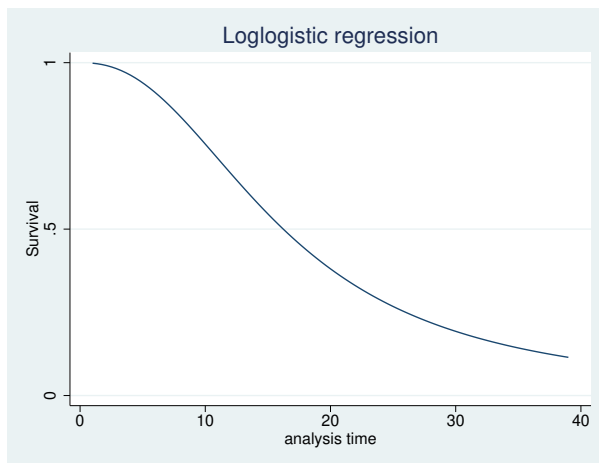


Figure 3. Loglogistic survival distribution at mean value of all covariates

```
. stcurve, hazard
```

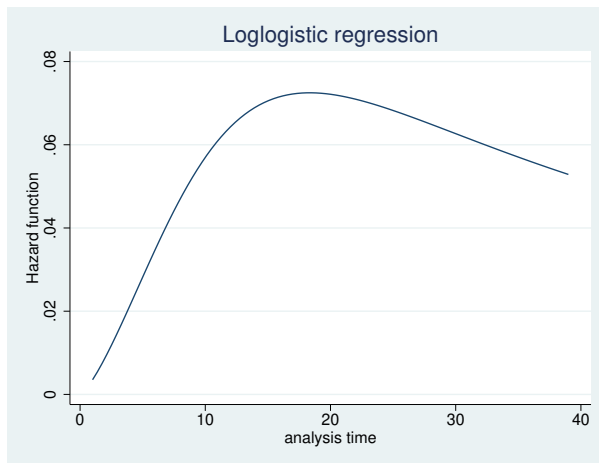


Figure 4. Loglogistic hazard distribution at mean value of all covariates

These plots show the fitted survivor and hazard functions evaluated for a cancer patient of average age receiving the average drug. Of course, the “average drug” has no meaning here because `drug` is an indicator variable. It makes more sense to plot the curves at a fixed value (level) of the drug. We can do this with the `at` option. For example, we may want to compare the average-age patient’s survival curve under placebo (`drug==0`) and under treatment (`drug==1`).

We can plot both curves on the same graph:

```
. stcurve, survival at(drug=(0 1)) ylabel(0 .5 1)
```

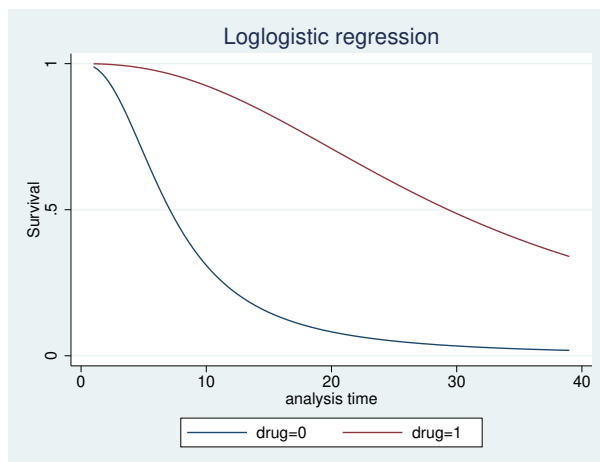


Figure 5. Loglogistic survival distribution at mean age for placebo

In the plot, we can see from the loglogistic model that the survival experience of an average-age patient receiving the placebo is worse than the survival experience of that same patient receiving treatment. We can also see the accelerated-failure-time feature of the loglogistic model. The survivor function for treatment is a time-decelerated (stretched-out) version of the survivor function for placebo.

◀

► Example 4

In our discussion of frailty models in [ST] [streg](#), we emphasize the distinction between the individual hazard (or survivor) function and the hazard (survivor) function for the population. When significant frailty is present, the population hazard will tend to begin falling past a certain point, regardless of the shape of the individual hazard. This is due to the frailty effect—as time passes, the frailer individuals will fail, leaving a more homogeneous population comprising only the most robust individuals.

The frailty effect may be demonstrated using `stcurve` to plot the estimated hazard (both individual and population) after fitting a frailty model. Use the `alpha1` option to specify the individual hazard ($\alpha = 1$) and the `unconditional` option to specify the population hazard. Applying this to the Weibull/inverse-Gaussian shared-frailty model on the kidney data of [example 11](#) of [ST] [streg](#),

```
. use https://www.stata-press.com/data/r16/catheter, clear
(Kidney data, McGilchrist and Aisbett, Biometrics, 1991)
. stset time infect
  (output omitted)
. quietly streg age female, distribution(weibull) frailty(invgauss)
> shared(patient)
```

```
. stcurve, hazard at(female=1) alpha1
```

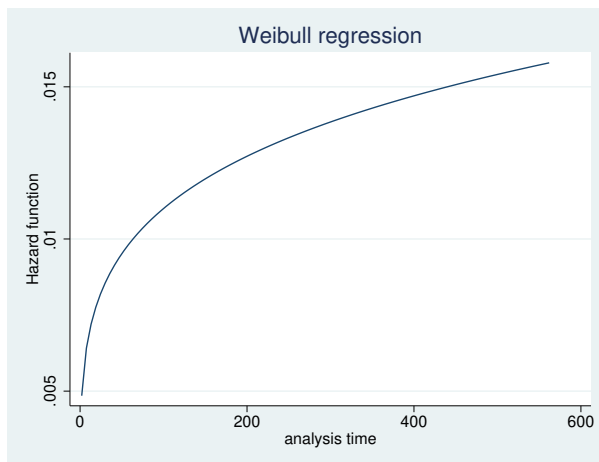


Figure 6. Individual hazard for females at mean age

Compare with

```
. stcurve, hazard at(female=1) unconditional
```

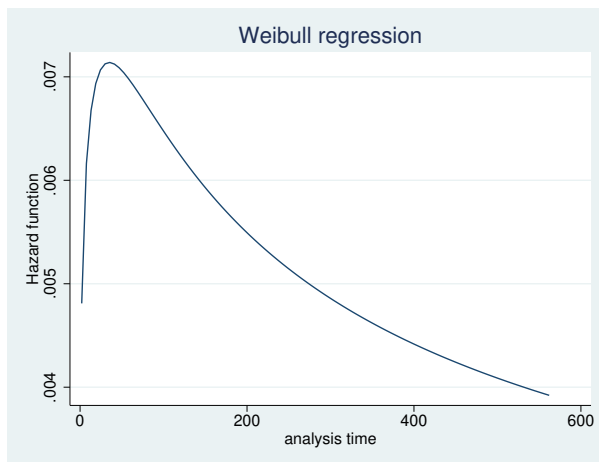


Figure 7. Population hazard for females at mean age

stcurve after stcrreg

► Example 5

In [ST] `stcrreg`, we analyzed data from 109 patients with primary cervical cancer, treated at a cancer center between 1994 and 2000. We fit a competing-risks regression model where local relapse was the failure event (`failtype == 1`), distant relapse with no local relapse was the competing risk event (`failtype == 2`), and we were interested primarily in the effect of interstitial fluid pressure (`ifp`) while controlling for tumor size and pelvic node involvement.

After fitting the competing-risks regression model, we can use `stcurve` to plot the estimated cumulative incidence of local relapses in the presence of the competing risk. We wish to compare the cumulative incidence curves for `ifp == 5` versus `ifp == 20`, assuming positive pelvic node involvement (`pelnode == 0`) and a tumor size that is the average over the data.

```
. use https://www.stata-press.com/data/r16/hypoxia
(Hypoxia study)
. stset dftime, fail(failtype==1)
(output omitted)
. stcrreg ifp tumsz pelnode, compete(failtype==2)
(output omitted)
. stcurve, cif at(ifp=(5 20) pelnode=0)
```

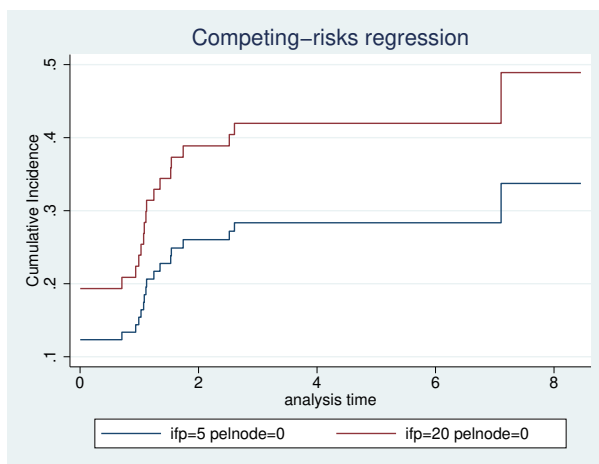


Figure 8. Comparative cumulative incidence functions

Specifying `ifp=(5 20)` in the `at()` option is the same as specifying the following `at#()` options:

```
. stcurve, cif at1(ifp=5 pelnode=0) at2(ifp=20 pelnode=0)
```

◀

stcurve after stintreg

`stcurve` can be used after `stintreg` to plot the fitted survivor, failure, hazard, or cumulative hazard function. For interval-censored data, these functions can be evaluated at a lower or upper time endpoint. `stcurve` plots the functions using the lower time endpoint. Without the `at()` option, `stcurve` computes the means of the covariates and evaluates the function at the means and at each

time in the data, censored or uncensored. The resulting plot is therefore the survival experience of a subject with a covariate pattern equal to the average covariate pattern in the study. You can produce the plot at other values of the covariates by using the `at()` option or specify a time range by using the `range()` option.

▷ Example 6

We continue with [example 1](#) of [ST] **stintreg**, which studies the effect of treatment on breast retraction for breast cancer patients. In that example, we compared the cosmetic effects of two cancer treatments, radiotherapy alone versus radiotherapy plus adjuvant chemotherapy, by fitting a Weibull proportional hazards model:

```
. use https://www.stata-press.com/data/r16/cosmesis
(Cosmetic Deterioration of Breast Cancer Patients)
. stintreg i.treat, interval(ltime rtime) distribution(weibull)
  (iteration log omitted)
```

```
Weibull PH regression
```

	Number of obs	=	94
	Uncensored	=	0
	Left-censored	=	5
	Right-censored	=	38
	Interval-cens.	=	51
	LR chi2(1)	=	10.93
Log likelihood = -143.19228	Prob > chi2	=	0.0009

	Haz. Ratio	Std. Err.	z	P> z	[95% Conf. Interval]	
<i>treat</i>						
Radio+Chemo	2.498526	.7069467	3.24	0.001	1.434961	4.350383
_cons	.0018503	.0013452	-8.66	0.000	.000445	.007693
<i>/ln_p</i>	.4785786	.1198972	3.99	0.000	.2435844	.7135729
<i>p</i>	1.613779	.1934876			1.275814	2.041271
<i>1/p</i>	.6196635	.0742959			.4898907	.7838134

Note: `_cons` estimates baseline hazard.

Now, we wish to compare the average patient's survival curve under radiotherapy only (`treat == 0`) and under radiotherapy plus chemotherapy (`treat == 1`):

```
. stcurve, survival at(treat=(0 1))
```

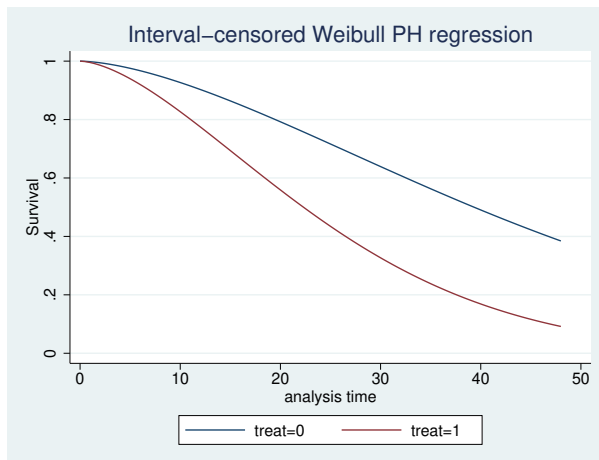


Figure 9. Treatment-specific survivor functions for Weibull proportional hazards model

From figure 9, we see that the risk of developing breast retraction for an average patient receiving the radiotherapy-plus-chemotherapy treatment is higher than that for the same patient receiving radiotherapy-only treatment. In other words, the adjuvant chemotherapy increases the risk of breast retraction.

◀

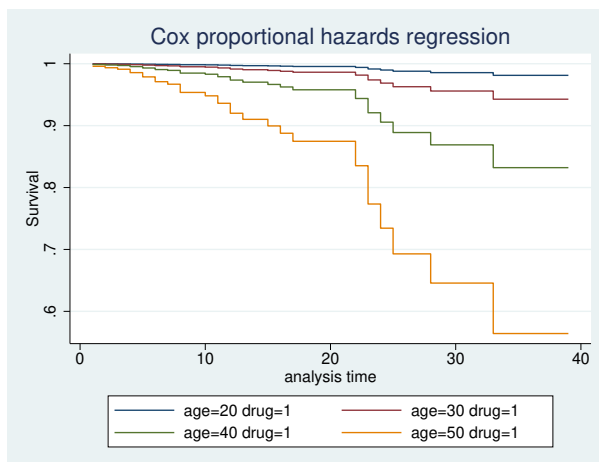
Using `at()` with `stcurve`

`stcurve`, by default, evaluates the function by setting each covariate to its mean value. The `at()` option specifies that the function be evaluated at the values of the covariates listed in `at()` and at the means of all unlisted covariates. You can repeat the `at()` option to produce multiple curves corresponding to different sets of covariate values.

Example 7

Let's return to [example 1](#). Suppose that we want to compare the survival curves for patients at ages 20, 30, 40, and 50 of the treatment group. The easiest way to do this is to specify multiple values for `age` in `at(numlist)`.

```
. use https://www.stata-press.com/data/r16/drugtr
(Patient Survival in Drug Trial)
. qui stcox age drug
. stcurve, survival at(age=(20(10)50) drug=1)
```

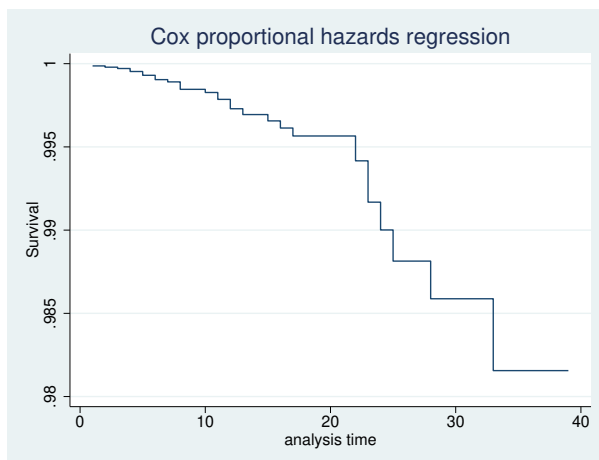


We could have obtained the same plot by specifying the `at#()` options but with more typing:

```
. stcurve, survival at1(age=20 drug=1) at2(age=30 drug=1) ///
  at3(age=40 drug=1) at4(age=50 drug=1)
```

The `at()` option provides many other flexible specifications. For example, if we would like to plot the baseline survivor function, we do not need to set every covariate to zero in `at()`. We can set all covariates to zero at once as follows:

```
. stcurve, survival at((zero) _all)
```



For details about the `at()` option, see *Syntax of at()* in [ST] *adjustfor_option*.



References

- Cefalu, M. S. 2011. Pointwise confidence intervals for the covariate-adjusted survivor function in the Cox model. *Stata Journal* 11: 64–81.
- Ruhe, C. 2016. Estimating survival functions after stcox with time-varying coefficients. *Stata Journal* 16: 867–879.

Also see

- [ST] **stcox** — Cox proportional hazards model
- [ST] **stcox postestimation** — Postestimation tools for stcox
- [ST] **stcrreg** — Competing-risks regression
- [ST] **stcrreg postestimation** — Postestimation tools for stcrreg
- [ST] **stintreg** — Parametric models for interval-censored survival-time data
- [ST] **stintreg postestimation** — Postestimation tools for stintreg
- [ST] **streg** — Parametric survival models
- [ST] **streg postestimation** — Postestimation tools for streg
- [ST] **sts** — Generate, graph, list, and test the survivor and related functions
- [ST] **stset** — Declare data to be survival-time data
- [ST] **adjustfor_option** — Adjust survivor and related functions for covariates at specific values
- [ME] **mestreg** — Multilevel mixed-effects parametric survival models
- [ME] **mestreg postestimation** — Postestimation tools for mestreg
- [XT] **xtstreg** — Random-effects parametric survival models
- [XT] **xtstreg postestimation** — Postestimation tools for xtstreg