Description Remarks and examples Also see

Description

In this example, we demonstrate how to fit parametric survival models with gsem. Specifically, in this example, we fit an exponential model, but much of the discussion applies to Weibull, gamma, loglogistic, and lognormal models as well.

. use https://www.stata-press.com/data/r19/gsem_kva (Generator experiment) . describe Contains data from https://www.stata-press.com/data/r19/gsem kva.dta Observations: 12 Generator experiment 23 Jan 2025 21:41 Variables: 3 (dta has notes) Variable Storage Display Value name format label Variable label type failtime Time until failure (hrs.) int %9.0g %9.0g Overload (kVA) load byte byte %9.0g Has new bearings bearings Sorted by:

. notes

_dta:

- 1. Artificial experimental data on two types of bearings in emergency generators.
- The purpose is to compare the ability to withstand overloads of new-style bearings to old-style bearings.
- 3. All generators are run until failure.
- 4. Experiments were performed under overloads of 20, 25, 30, 35, and 40 kVA.

See Structural models 7: Survival models in [SEM] Intro 5 for background.

Remarks and examples

Remarks are presented under the following headings:

Fitting the exponential model Obtaining hazard ratios Fitting the model with the Builder

Fitting the exponential model

We wish to fit the following model:



That is, we wish to fit an exponential model in which the failure time of bearings (failtime) depends on the amount of overload (load) and whether the bearings are the new style (bearings = 1) or the old style (bearings = 0).

To fit this model, we use the gsem command with the exponential option.

. gsem (failt	ime <- load i.	bearings),	exponent	ial		
Iteration 0: Iteration 1: Iteration 2: Iteration 3: Iteration 4: Iteration 5: Iteration 6:	Log likelihoo Log likelihoo Log likelihoo Log likelihoo Log likelihoo Log likelihoo Log likelihoo	d = -84108 d = -67.363 d = -66.855 d = -62.300 d = -62.227 d = -62.227 d = -62.227	.99 768 013 033 842 568 568			
Generalized s Response: fai Family: Exp Form: Proj Link: Log Log likelihoo	tructural equa ltime onential portional haza d = -62.227568	tion model rds			Number of obs No. of failure Time at risk	= 12 s = 12 = 896.00
	Coefficient	Std. err.	Z	P> z	[95% conf.	interval]
failtime						
load	.0611166	.0354318	1.72	0.085	0083284	.1305616
1.bearings	2194825	.5773503	-0.38	0.704	-1.351068	.9121033
_cons	-5.756595	1.056403	-5.45	0.000	-7.827106	-3.686084

Notes:

- 1. By default, exponential models are fit in the proportional-hazards metric. The exponential option can be replaced with family(exponential, aft) if you want to fit the model in the accelerated failure-time metric.
- 2. gsem reports coefficients, which match those reported by the equivalent streg command,

. stset failtime . streg load bearings, distribution(exponential) nohr

3. Without the nohr option, streg reports hazard ratios, which are the exponentiated coefficients.

Obtaining hazard ratios

The estat eform command reports exponentiated coefficients for models fit with gsem, so we can obtain hazard ratios as follows.

. estat elorm										
	exp(b)	Std. err.	z	P> z	[95% conf.	interval]				
failtime										
load	1.063023	.0376648	1.72	0.085	.9917062	1.139468				
1.bearings	.8029342	.4635743	-0.38	0.704	.2589635	2.489553				
_cons	.0031619	.0033402	-5.45	0.000	.0003988	.02507				

The hazard ratio of 0.80 for bearings = 1 indicates that the predicted hazard of failure for the new style of bearing is 80% of the hazard for a bearing of the old type, provided that they have the same loading.

Fitting the model with the Builder

Use the diagram in Fitting the exponential model above for reference.

1. Open the dataset.

In the Command window, type

. use https://www.stata-press.com/data/r19/gsem_kva

2. Open a new Builder diagram.

Select menu item Statistics > SEM (structural equation modeling) > Model building and estimation.

- 3. Put the Builder in gsem mode by clicking on the $\frac{G}{SEM}$ button.
- 4. Create the exponential regression component for failtime.

Select the Add regression component tool, [▶], and then click in the diagram about one-third of the way in from the left and halfway down.

In the resulting dialog box,

- a. select failtime in the Dependent variable control;
- b. check Make response generalized;
- c. select Exponential, Log in the Family/Link control;
- d. select the Select variables radio button (it may already be selected);
- e. use the Independent variables control to select the variable load;
- f. include the levels of the factor variable bearings by clicking on the "button next to the Independent variables control. In the resulting dialog box, select the Factor variable radio button, select Main effect in the Specification control, and select bearings in the Variables control for Variable 1. Click on Add to varlist, and then click on OK;
- g. select Left in the Independent variables' direction control;
- h. click on OK.

If you wish, move the component by clicking on any variable and dragging it.

5. Clean up.

The box for failtime is created closer to the independent variables than it is in the example diagram. Use the Select tool, **b**, and click on the box for failtime. Drag it to the right to allow more space for results along the paths.

6. Estimate.

Click on the **Estimate** button, \mathbb{P} , in the Standard Toolbar, and then click on **OK** in the resulting *GSEM* estimation options dialog box.

You can open a completed diagram in the Builder by typing

. webgetsem gsem_exp

Also see

- [SEM] Example 48g Loglogistic survival model with censored and truncated data
- [SEM] Example 49g Multiple-group Weibull survival model
- [SEM] Intro 5 Tour of models
- [SEM] gsem Generalized structural equation model estimation command
- [SEM] estat eform Display exponentiated coefficients

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