

Example 49g — Multiple-group Weibull survival model
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Description

Below we demonstrate `gsem`'s `group()` option, which allows us to fit models in which coefficients, intercepts, and other types of parameters differ across groups of the data. We will fit a Weibull model to the following survival data

```
. use https://www.stata-press.com/data/r18/gsem_cancer
(Patient survival in drug trial)
. describe
Contains data from https://www.stata-press.com/data/r18/gsem_cancer.dta
Observations:      48      Patient survival in drug trial
Variables:         4      16 Jan 2023 15:41
                        (_dta has notes)
```

Variable name	Storage type	Display format	Value label	Variable label
studytime	byte	%8.0g		Months to death or end of exp.
died	byte	%8.0g		1 if patient died
drug	byte	%8.0g		Drug type (1=placebo)
age	byte	%8.0g		Patient's age at start of exp.

Sorted by:

```
. notes
_dta:
  1. Artificial data on cancer patient survival.
  2. Drug 1 is a placebo. Drugs 2 and 3 are alternative treatments.
```

See [\[SEM\] Example 47g](#) and [\[SEM\] Example 48g](#) for how to fit survival models using `gsem`. In this example, we focus on fitting multiple-group models using `gsem`'s `group()` and `ginvariant()` options. See [\[SEM\] Intro 6](#) for background on these options.

Remarks and examples

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Remarks are presented under the following headings:

[Fitting the multiple-group model](#)
[Fitting the model with the Builder](#)

Fitting the multiple-group model

We want to fit the model



If we do not allow for group differences, we can fit this model by typing

```
. gsem (studytime <- age, family(weibull, failure(died)))
```

However, this study used one placebo and two drugs. We want to allow the intercept and auxiliary parameter to vary across the levels of drug but constrain the coefficient on age to be equal across the levels of drug. In other words, we want to fit a stratified Weibull model. We add the `group(drug)` and `ginvariant(coef)` options to our `gsem` command to specify that drug is the group identifier and that coefficients should not vary across groups.

```
. gsem (studytime <- age, family(weibull, failure(died))),
> group(drug) ginvariant(coef)
```

(iteration log omitted)

```
Generalized structural equation model                Number of obs   = 48
Grouping variable: drug                            Number of groups = 3
Log likelihood = -109.28976
```

```
( 1) [studytime]1bn.drug#c.age - [studytime]3.drug#c.age = 0
( 2) [studytime]2.drug#c.age - [studytime]3.drug#c.age = 0
```

```
Group: 1                                           Number of obs   = 20
Response: studytime                               No. of failures = 19
Family: Weibull                                   Time at risk    = 180.00
Form: Proportional hazards
Link: Log
```

	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
studytime						
age	.1212332	.0367538	3.30	0.001	.049197	.1932694
_cons	-10.36921	2.341022	-4.43	0.000	-14.95753	-5.780896
/studytime						
ln_p	.4541282	.1715663			.1178645	.7903919

```
Group: 2                                           Number of obs   = 14
Response: studytime                               No. of failures = 6
Family: Weibull                                   Time at risk    = 209.00
Form: Proportional hazards
Link: Log
```

	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
studytime						
age	.1212332	.0367538	3.30	0.001	.049197	.1932694
_cons	-14.93039	3.445179	-4.33	0.000	-21.68282	-8.177965
/studytime						
ln_p	.9413477	.2943728			.3643876	1.518308

```

Group:      3                               Number of obs =    14
Response:  studytime                       No. of failures =    6
Family:    Weibull                          Time at risk  = 355.00
Form:      Proportional hazards
Link:      Log
    
```

	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
studytime						
age	.1212332	.0367538	3.30	0.001	.049197	.1932694
_cons	-14.08495	3.242463	-4.34	0.000	-20.44006	-7.72984
/studytime						
ln_p	.6735495	.369625			-.0509022	1.398001

Notes:

1. In [\[SEM\] Intro 6](#), we wrote that gsem classifies each parameter into one of seven classes, which are the following:

Class description	Class name
1. intercepts and cutpoints	cons
2. fixed coefficients	coef
3. latent variable coefficients	loading
4. covariances of errors	errvar
5. scaling parameters	scale
6. means of exogenous variables	means
7. covariances of exogenous latent variables	covex
8. all the above	all
9. none of the above	none

By default, classes 1, 2, and 3 are constrained to be equal, and the others are allowed to vary.

2. In the output, we have a separate table of parameter estimates for each level of drug. The coefficient on age is 0.12 in all groups, but, as expected, the other parameters differ across groups.

We can replay the results with the `byparm` option to request that results be sorted by parameter rather than by groups. This output makes it easy to compare estimates across the groups. Alternatively, we could have added the `byparm` option when we fit the model.

```

. gsem, byparm
Generalized structural equation model           Number of obs =    48
Grouping variable: drug                       Number of groups =    3
Group:    1                                   Number of obs =    20
Response: studytime                          No. of failures =    19
Family:   Weibull                             Time at risk  = 180.00
Form:     Proportional hazards
Link:     Log
Group:    2                                   Number of obs =    14
Response: studytime                          No. of failures =     6
Family:   Weibull                             Time at risk  = 209.00
Form:     Proportional hazards
Link:     Log
    
```

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```
Group:      3                      Number of obs   =    14
Response:  studytime              No. of failures =     6
Family:    Weibull                Time at risk    = 355.00
Form:      Proportional hazards
Link:      Log
```

```
Log likelihood = -109.28976
```

```
( 1) [studytime]1bn.drug#c.age - [studytime]3.drug#c.age = 0
( 2) [studytime]2.drug#c.age - [studytime]3.drug#c.age = 0
```

	Coefficient	Std. err.	z	P> z	[95% conf. interval]	
studytime						
age						
1	.1212332	.0367538	3.30	0.001	.049197	.1932694
2	.1212332	.0367538	3.30	0.001	.049197	.1932694
3	.1212332	.0367538	3.30	0.001	.049197	.1932694
_cons						
1	-10.36921	2.341022	-4.43	0.000	-14.95753	-5.780896
2	-14.93039	3.445179	-4.33	0.000	-21.68282	-8.177965
3	-14.08495	3.242463	-4.34	0.000	-20.44006	-7.72984
/studytime						
ln_p						
1	.4541282	.1715663			.1178645	.7903919
2	.9413477	.2943728			.3643876	1.518308
3	.6735495	.369625			-.0509022	1.398001

The estimated intercepts, labeled `_cons` in the first section of the table, do not vary much across groups. We can perform a Wald test of whether these coefficients are the same using the `test` command. If we replay the results by typing `gsem, coeflegend`, we find that we can refer to the three intercepts as `_b[studytime:1.drug]`, `_b[studytime:2.drug]`, and `_b[studytime:3.drug]`. Therefore, our test command is

```
. test _b[studytime:1.drug]=_b[studytime:2.drug]=_b[studytime:3.drug]
( 1) [studytime]1bn.drug - [studytime]2.drug = 0
( 2) [studytime]1bn.drug - [studytime]3.drug = 0
      chi2( 2) =    5.49
      Prob > chi2 =    0.0641
```

Using a 5% significance level, we fail to reject the null hypothesis that the intercepts are equal. If we wanted to refit the model based on these findings, we could include `cons` in the `ginvariant()` option as follows and constrain both the coefficients and the intercepts across groups.

```
. gsem (studytime <- age, family(weibull, failure(died))), ///
      group(drug) ginvariant(coef cons)
```

Fitting the model with the Builder

Use the diagram in *Fitting the multiple-group model* above for reference.

1. Open the dataset.

In the Command window, type

```
. use https://www.stata-press.com/data/r18/gsem_cancer
```

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  button.

4. Create the Weibull regression component for *studytime*.

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,

- select *studytime* in the *Dependent variable* control;
- check *Make response generalized*;
- select *Weibull, Log* in the *Family/Link* control;
- select the *Select variables* radio button (it may already be selected);
- use the *Independent variables* control to select the variable *age*;
- select *Left* in the *Independent variables' direction* control;
- click on **OK**.

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

5. Specify the censoring variable.

- Choose the Select tool, .
- Click on the box for *studytime*.
- In the Contextual Toolbar, click on the **Properties...** button.
- In the resulting *Variable properties* dialog box, click on the **Failure and truncation...** button in the **Variable** tab.
- In the resulting *Failure and truncation* dialog box, select *died* in the *Failure variable* control. Click on **OK**.
- Click on **OK** in the *Variables properties* dialog box.

6. Clean up.

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

7. Estimate.

Click on the **Estimate** button, , in the Standard Toolbar.

In the resulting dialog box, do the following:

- Select the **Group** tab.
- Select the *Group analysis* radio button. Select the variable *drug* in the *Group variable* control.
- Select *Fixed coefficients* in the *Parameters that are equal across groups* control.
- Click on **OK**.

- e. In the Standard Toolbar, use the *Group* control to toggle between results for group 1 and group 2.

You can open a completed diagram in the Builder by typing

```
. webgetsem gsem_grp
```

Also see

[SEM] [Example 47g](#) — Exponential survival model

[SEM] [Example 48g](#) — Loglogistic survival model with censored and truncated data

[SEM] [Intro 5](#) — Tour of models

[SEM] [Intro 6](#) — Comparing groups

[SEM] [gsem](#) — Generalized structural equation model estimation command

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