

bayes: meglm — Bayesian multilevel generalized linear model

Description	Quick start	Menu	Syntax
Remarks and examples	Stored results	Methods and formulas	Also see

Description

`bayes: meglm` fits a Bayesian multilevel generalized linear model to outcomes of different types such as continuous, binary, count, and so on; see [\[BAYES\] bayes](#) and [\[ME\] meglm](#) for details.

Quick start

Bayesian two-level generalized linear model of `y` on `x1` and `x2` with random intercepts by `id`, using the Gaussian family and log link, and using default normal priors for regression coefficients and default inverse-gamma prior for the variance of random intercepts

```
bayes: meglm y x1 x2 || id:, family(gaussian) link(log)
```

Use a standard deviation of 10 instead of 100 for the default normal priors

```
bayes, normalprior(10): meglm y x1 x2 || id:, family(gaussian) link(log)
```

Use uniform priors for the slopes and a normal prior for the intercept

```
bayes, prior({y: x1 x2}, uniform(-10,10)) ///
prior({y: _cons}, normal(0,10)): ///
meglm y x1 x2 || id:, family(gaussian) link(log)
```

Save simulation results to `simdata.dta`, and use a random-number seed for reproducibility

```
bayes, saving(simdata) rseed(123): ///
meglm y x1 x2 || id:, family(gaussian) link(log)
```

Specify 20,000 Markov chain Monte Carlo (MCMC) samples, set length of the burn-in period to 5,000, and request that a dot be displayed every 500 simulations

```
bayes, mcmcsize(20000) burnin(5000) dots(500): ///
meglm y x1 x2 || id:, family(gaussian) link(log)
```

In the above, request that the 90% highest posterior density (HPD) credible interval be displayed instead of the default 95% equal-tailed credible interval

```
bayes, clevel(90) hpd
```

Fit a logit model and display results as odds ratios

```
bayes: meglm z x1 x2 || id:, family(binomial) eform
```

Display odds ratios on replay

```
bayes, eform
```

Also see [Quick start](#) in [\[BAYES\] bayes](#) and [Quick start](#) in [\[ME\] meglm](#).

Menu

Statistics > Multilevel mixed-effects models > Bayesian regression > Generalized linear model (GLM)

Syntax

```
bayes [ , bayesopts ] : meglm depvar fe_equation
      [ || re_equation ] [ || re_equation ... ] [ , options ]
```

where the syntax of *fe_equation* is

```
[ indepvars ] [ if ] [ in ] [ weight ] [ , fe_options ]
```

and the syntax of *re_equation* is one of the following:

for random coefficients and intercepts

```
levelvar: [ varlist ] [ , re_options ]
```

for random effects among the values of a factor variable

```
levelvar: R.varname
```

levelvar either is a variable identifying the group structure for the random effects at that level or is `_all`, representing one group comprising all observations.

<i>fe_options</i>	Description
<code>Model</code>	
<code><u>noconstant</u></code>	suppress constant term from the fixed-effects equation
<code><u>exposure</u>(<i>varname_e</i>)</code>	include $\ln(\text{varname}_e)$ in model with coefficient constrained to 1
<code><u>offset</u>(<i>varname_o</i>)</code>	include <i>varname_o</i> in model with coefficient constrained to 1
<code>asis</code>	retain perfect predictor variables

<i>re_options</i>	Description
<code>Model</code>	
<code><u>covariance</u>(<i>vartype</i>)</code>	variance–covariance structure of the random effects ; only structures <code>independent</code> , <code>exchangeable</code> , <code>identity</code> , and <code>unstructured</code> are supported
<code><u>noconstant</u></code>	suppress constant term from the random-effects equation

<i>options</i>	Description
Model	
<u>f</u> amily(<i>family</i>)	distribution of <i>depvar</i> ; default is family(gaussian)
<u>l</u> ink(<i>link</i>)	link function; default varies per family
Reporting	
eform	report exponentiated coefficients
irr	report incidence-rate ratios
or	report odds ratios
<u>n</u> otable	suppress coefficient table
<u>n</u> oheader	suppress output header
<u>n</u> ogroup	suppress table summarizing groups
<i>display_options</i>	control spacing, line width, and base and empty cells
<u>l</u> evel(#)	set credible level; default is level(95)

indepvars may contain factor variables; see [U] 11.4.3 Factor variables.

depvar, *indepvars*, and *varlist* may contain time-series operators; see [U] 11.4.4 Time-series varlists.

fweights are allowed; see [U] 11.1.6 weight.

bayes: meglm, level() is equivalent to bayes, clevel(): meglm.

For a detailed description of *options*, see *Options* in [ME] meglm.

<i>bayesopts</i>	Description
Priors	
* <u>n</u> ormalprior(#)	specify standard deviation of default normal priors for regression coefficients; default is normalprior(100)
* <u>i</u> gammaprior(# #)	specify shape and scale of default inverse-gamma prior for variance components; default is igammaprior(0.01 0.01)
* <u>i</u> wishartprior(# [...])	specify degrees of freedom and, optionally, scale matrix of default inverse-Wishart prior for unstructured random-effects covariance
<u>p</u> rior(<i>priorspec</i>)	prior for model parameters; this option may be repeated
<u>d</u> ryrun	show model summary without estimation
Simulation	
<u>n</u> chains(#)	number of chains; default is to simulate one chain
<u>m</u> cmcsizе(#)	MCMC sample size; default is mcmcsizе(10000)
<u>b</u> urnin(#)	burn-in period; default is burnin(2500)
<u>t</u> hinning(#)	thinning interval; default is thinning(1)
<u>r</u> seed(#)	random-number seed
<u>e</u> xclude(<i>paramref</i>)	specify model parameters to be excluded from the simulation results
<u>r</u> estubs(<i>restub1 restub2 ...</i>)	specify stubs for random-effects parameters for all levels
Blocking	
* <u>b</u> locksize(#)	maximum block size; default is blocksize(50)
<u>b</u> lock(<i>paramref</i> [, <i>blockopts</i>])	specify a block of model parameters; this option may be repeated
<u>b</u> locksummary	display block summary
* <u>n</u> oblocking	do not block parameters by default

Initialization

<u>initial</u> (<i>initspec</i>)	specify initial values for model parameters with a single chain
<u>init</u> #(<i>initspec</i>)	specify initial values for #th chain; requires <code>nchains()</code>
<u>initall</u> (<i>initspec</i>)	specify initial values for all chains; requires <code>nchains()</code>
<u>nomleinitial</u>	suppress the use of maximum likelihood estimates as starting values
<u>initrandom</u>	specify random initial values
<u>initsummary</u>	display initial values used for simulation
* <u>noisily</u>	display output from the estimation command during initialization

Adaptation

<u>adaptation</u> (<i>adaptopts</i>)	control the adaptive MCMC procedure
<u>scale</u> (#)	initial multiplier for scale factor; default is <code>scale(2.38)</code>
<u>covariance</u> (<i>cov</i>)	initial proposal covariance; default is the identity matrix

Reporting

<u>clevel</u> (#)	set credible interval level; default is <code>clevel(95)</code>
<u>hpd</u>	display HPD credible intervals instead of the default equal-tailed credible intervals
* <u>irr</u>	report incidence-rate ratios
* <u>or</u>	report odds ratios
<u>eform</u> [(<i>string</i>)]	report exponentiated coefficients and, optionally, label as <i>string</i>
<u>remargl</u>	compute log marginal-likelihood; suppressed by default
<u>remargl</u>	compute log marginal-likelihood
<u>batch</u> (#)	specify length of block for batch-means calculations; default is <code>batch(0)</code>
<u>saving</u> (<i>filename</i> [, <i>replace</i>])	save simulation results to <i>filename.dta</i>
<u>nomodelsummary</u>	suppress model summary
<u>nonesummary</u>	suppress multilevel-structure summary
<u>chainsdetail</u>	display detailed simulation summary for each chain
[<u>no</u>] <u>dots</u>	suppress dots or display dots every 100 iterations and iteration numbers every 1,000 iterations; default is <code>dots</code>
<u>dots</u> (#[, <i>every</i> (#))	display dots as simulation is performed
[<u>no</u>] <u>show</u> (<i>paramref</i>)	specify model parameters to be excluded from or included in the output
<u>showeffects</u> [(<i>ref</i>)]	specify that all or a subset of random-effects parameters be included in the output
<u>melabel</u>	display estimation table using the same row labels as <code>meglm</code>
<u>nogroup</u>	suppress table summarizing groups
<u>notable</u>	suppress estimation table
<u>noheader</u>	suppress output header
<u>title</u> (<i>string</i>)	display <i>string</i> as title above the table of parameter estimates
<u>display_options</u>	control spacing, line width, and base and empty cells

Advanced

<u>search</u> (<i>search_options</i>)	control the search for feasible initial values
<u>corrlag</u> (#)	specify maximum autocorrelation lag; default varies
<u>corrtol</u> (#)	specify autocorrelation tolerance; default is <code>corrtol(0.01)</code>

*Starred options are specific to the bayes prefix; other options are common between bayes and bayesmh.

Options prior() and block() may be repeated.

priorspec and paramref are defined in [BAYES] bayesmh.

paramref may contain factor variables; see [U] 11.4.3 Factor variables.

collect is allowed; see [U] 11.1.10 Prefix commands.

See [U] 20 Estimation and postestimation commands for more capabilities of estimation commands.

Model parameters are regression coefficients {depvar:indepvars}, parameters as described in Additional model parameters, random effects {rename}, and either variance components {rename:sigma2} or, if option covariance(unstructured) is specified, matrix parameter {restub:Sigma,matrix}; see Likelihood model in [BAYES] bayes for how renames and restub are defined. Use the dryrun option to see the definitions of model parameters prior to estimation.

For a detailed description of bayesopts, see Options in [BAYES] bayes.

Remarks and examples

stata.com

For a general introduction to Bayesian analysis, see [BAYES] Intro. For a general introduction to Bayesian estimation using an adaptive Metropolis–Hastings algorithm, see [BAYES] bayesmh. For remarks and examples specific to the bayes prefix, see [BAYES] bayes. For details about the estimation command, see [ME] meglm.

For a simple example of the bayes prefix, see Introductory example in [BAYES] bayes. For multilevel examples, see Multilevel models in [BAYES] bayes. Also see Crossed-effects model in [BAYES] bayes.

Additional model parameters

In addition to regression coefficients {depvar:indepvars}, bayes: meglm defines extra parameters that depend on the chosen family; see table 1 below.

Table 1. Additional model parameters defined by bayes: meglm

Family	Parameter	Model parameter	Default prior
Gaussian	Error variance	{e.depvar:sigma2}	InvGamma(0.01, 0.01)
Bernoulli/Binomial	None	None	None
Ordinal	Cutpoints	{cut1}, {cut2}, ...	Flat
Poisson	None	None	None
Negative binomial	Log-overdispersion	{lnalpha} (mean disp.) {lndelta} (constant disp.)	$N(0, 10000)$ $N(0, 10000)$
Gamma	Log-scale	{lnscale}	$N(0, 10000)$

Use the dryrun option with the bayes prefix to see the definitions of model parameters prior to estimation.

Stored results

See Stored results in [BAYES] bayes.

Methods and formulas

See *Methods and formulas* in [BAYES] **bayesmh**.

Also see

[BAYES] **bayes** — Bayesian regression models using the bayes prefix

[ME] **meglm** — Multilevel mixed-effects generalized linear model

[BAYES] **Bayesian postestimation** — Postestimation tools for bayesmh and the bayes prefix

[BAYES] **Bayesian estimation** — Bayesian estimation commands

[BAYES] **Bayesian commands** — Introduction to commands for Bayesian analysis

[BAYES] **Intro** — Introduction to Bayesian analysis

[BAYES] **Glossary**