

bayes: meglm — Bayesian multilevel generalized linear model

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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 x_1 and x_2 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 MCMC samples, set length of the burn-in period to 5,000, and request that a dot be displayed every 500 simulations

```
bayes, mcmcsample(20000) burnin(5000) dots(500): ///
```

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

In the above, request that the 90% 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 models (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>identity</code> , and <code>unstructured</code> supported
<code><u>noconstant</u></code>	suppress constant term from the random-effects equation

<i>options</i>	Description
Model	
<code>family(<i>family</i>)</code>	distribution of <i>depvar</i> ; default is <code>family(gaussian)</code>
<code>link(<i>link</i>)</code>	link function; default varies per family
<code>collinear</code>	keep collinear variables
Reporting	
<code>eform</code>	report exponentiated coefficients
<code>irr</code>	report incidence-rate ratios
<code>or</code>	report odds ratios
<code>notable</code>	suppress coefficient table
<code>noheader</code>	suppress output header
<code>nogroup</code>	suppress table summarizing groups
<code>display_options</code>	control spacing, line width, and base and empty cells
<code>level(#)</code>	set credible level; default is <code>level(95)</code>

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	
* <code>normalprior(#)</code>	specify standard deviation of default normal priors for regression coefficients; default is <code>normalprior(100)</code>
* <code>igammaprior(# #)</code>	specify shape and scale of default inverse-gamma prior for variance components; default is <code>igammaprior(0.01 0.01)</code>
* <code>iwishartprior(# [...])</code>	specify degrees of freedom and, optionally, scale matrix of default inverse-Wishart prior for unstructured random-effects covariance
<code>prior(<i>priorspec</i>)</code>	prior for model parameters; this option may be repeated
<code>dryrun</code>	show model summary without estimation
Simulation	
<code>mcmcsize(#)</code>	MCMC sample size; default is <code>mcmcsize(10000)</code>
<code>burnin(#)</code>	burn-in period; default is <code>burnin(2500)</code>
<code>thinning(#)</code>	thinning interval; default is <code>thinning(1)</code>
<code>rseed(#)</code>	random-number seed
<code>exclude(<i>paramref</i>)</code>	specify model parameters to be excluded from the simulation results
<code>restubs(<i>restub1 restub2</i> ...)</code>	specify stubs for random-effects parameters for all levels
Blocking	
* <code>blocksize(#)</code>	maximum block size; default is <code>blocksize(50)</code>
<code>block(<i>paramref</i> [, <i>blockopts</i>])</code>	specify a block of model parameters; this option may be repeated
<code>blocksummary</code>	display block summary
* <code>noblocking</code>	do not block parameters by default

Initialization

<code><u>initial</u>(<i>initspec</i>)</code>	initial values for model parameters
<code><u>nomleinitial</u></code>	suppress the use of maximum likelihood estimates as starting values
<code><u>initrandom</u></code>	specify random initial values
<code><u>initsummary</u></code>	display initial values used for simulation
* <code><u>noisily</u></code>	display output from the estimation command during initialization

Adaptation

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

Reporting

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

Advanced

<code><u>search</u>(<i>search_options</i>)</code>	control the search for feasible initial values
<code><u>corrlag</u>(#)</code>	specify maximum autocorrelation lag; default varies
<code><u>corrtol</u>(#)</code>	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()` can be repeated.

`priorspec` and `paramref` are defined in [BAYES] `bayesmh`.

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

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](http://www.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	$\{cut1\}, \{cut2\}, \dots$	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] **bayesmh**.

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**