Title

> **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 $\big[$, *bayesopts* $\big]$: meglm *depvar fe_equation*
>
> $\big[$ || *re_equation* $\big]$ $\big[$ || *re_equation* ... $\big]$ $\big[$, *options* $\big]$

where the syntax of *fe_equation* is

> $\big[$ *indepvars* $\big]$ $\big[$ *if* $\big]$ $\big[$ *in* $\big]$ $\big[$ *weight* $\big]$ $\big[$, *fe_options* $\big]$

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

> for random coefficients and intercepts
>
>   *levelvar*: $\big[$ *varlist* $\big]$ $\big[$, *re_options* $\big]$
>
> 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.

fe_options	Description
Model	
noconstant	suppress constant term from the [fixed-effects](#) equation
exposure(*varname_e*)	include $\ln(varname_e)$ in model with coefficient constrained to 1
offset(*varname_o*)	include *varname_o* in model with coefficient constrained to 1
asis	retain perfect predictor variables

re_options	Description
Model	
covariance(*vartype*)	variance–covariance structure of the [random effects](#); only structures independent, exchangeable, identity, and unstructured are supported
noconstant	suppress constant term from the random-effects equation

options	Description
[Model]	
<u>f</u>amily(*family*)	distribution of *depvar*; default is family(gaussian)
<u>l</u>ink(*link*)	link function; default varies per family
[Reporting]	
eform	report exponentiated coefficients
irr	report incidence-rate ratios
or	report odds ratios
notable	suppress coefficient table
noheader	suppress output header
nogroup	suppress table summarizing groups
display_options	control spacing, line width, and base and empty cells
level(*#*)	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**.

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

Initialization

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

Adaptation

adaptation(*adaptopts*)	control the adaptive MCMC procedure
scale(#)	initial multiplier for scale factor; default is scale(2.38)
covariance(*cov*)	initial proposal covariance; default is the identity matrix

Reporting

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

Advanced

search(*search_options*)	control the search for feasible initial values
corrlag(#)	specify maximum autocorrelation lag; default varies
corrtol(#)	specify autocorrelation tolerance; default is corrtol(0.01)

∗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 *rename*s 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

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.)	$N(0, 10000)$
		{lndelta} (constant disp.)	$N(0, 10000)$
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 models

[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**

For suggested citations, see the FAQ on citing Stata documentation.