**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 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% 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

\[
\text{bayes\ [ ,\ bayesopts\ ] : meglm\ depvar\ fe\_equation}
\[
\quad [\ ||\ re\_equation\ ] [\ ||\ re\_equation\ ...\ ] [\ ,\ options\ ]
\]

where the syntax of \textit{fe\_equation} is

\[
[\ indepvars\ ] [\ if\ ] [\ in\ ] [\ weight\ ] [\ ,\ fe\_options\ ]
\]

and the syntax of \textit{re\_equation} is one of the following:

for random coefficients and intercepts

\[
\text{levelvar: [ varlist\ ] [\ ,\ re\_options\ ]}
\]

for random effects among the values of a factor variable

\[
\text{levelvar: R.\ varname}
\]

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

\begin{tabular}{ll}
\textit{fe\_options} & Description \\
\hline
\textbf{Model} & \\
\texttt{noconstant} & suppress constant term from the fixed-effects equation \\
\texttt{exposure(varname_e)} & include ln(varname_e) in model with coefficient constrained to 1 \\
\texttt{offset(varname_o)} & include varname_o in model with coefficient constrained to 1 \\
\texttt{asis} & retain perfect predictor variables \\
\hline
\textit{re\_options} & Description \\
\hline
\textbf{Model} & \\
\texttt{covariance(vartype)} & variance–covariance structure of the random effects; only structures independent, identity, and unstructured supported \\
\texttt{noconstant} & suppress constant term from the random-effects equation
\end{tabular}
Model

**family**(family) distribution of **depvar**; default is **family**(gaussian)

**link**(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**

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Priors</strong></td>
</tr>
<tr>
<td>specify standard deviation of default normal priors for regression coefficients; default is <strong>normalprior</strong>(100)</td>
</tr>
<tr>
<td>specify shape and scale of default inverse-gamma prior for variance components; default is <strong>igammaprior</strong>(0.01 0.01)</td>
</tr>
<tr>
<td>specify degrees of freedom and, optionally, scale matrix of default inverse-Wishart prior for unstructured random-effects covariance prior for model parameters; this option may be repeated</td>
</tr>
<tr>
<td>show model summary without estimation</td>
</tr>
<tr>
<td><strong>Simulation</strong></td>
</tr>
<tr>
<td>number of chains; default is to simulate one chain</td>
</tr>
<tr>
<td>MCMC sample size; default is <strong>mcmcsize</strong>(10000)</td>
</tr>
<tr>
<td>burn-in period; default is <strong>burnin</strong>(2500)</td>
</tr>
<tr>
<td>thinning interval; default is <strong>thinning</strong>(1)</td>
</tr>
<tr>
<td>random-number seed</td>
</tr>
<tr>
<td>specify model parameters to be excluded from the simulation results</td>
</tr>
<tr>
<td>specify stubs for random-effects parameters for all levels</td>
</tr>
<tr>
<td><strong>Blocking</strong></td>
</tr>
<tr>
<td>maximum block size; default is <strong>blocksize</strong>(50)</td>
</tr>
<tr>
<td>specify a block of model parameters; this option may be repeated</td>
</tr>
<tr>
<td>display block summary</td>
</tr>
<tr>
<td>do not block parameters by default</td>
</tr>
</tbody>
</table>
Initialization

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

Adaptation

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

Reporting

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

Advanced

\texttt{search(\textit{search\_options})} control the search for feasible initial values
\texttt{corrlag(\#)} specify maximum autocorrelation lag; default varies
\texttt{corrtol(\#)} specify autocorrelation tolerance; default is \texttt{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.

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` 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>
<thead>
<tr>
<th>Family</th>
<th>Parameter</th>
<th>Model parameter</th>
<th>Default prior</th>
</tr>
</thead>
<tbody>
<tr>
<td>Gaussian</td>
<td>Error variance</td>
<td><code>{e.depvar:sigma2}</code></td>
<td>InvGamma(0.01, 0.01)</td>
</tr>
<tr>
<td>Bernoulli/Binomial</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Ordinal</td>
<td>Cutpoints</td>
<td><code>{cut1},{cut2},...</code></td>
<td>Flat</td>
</tr>
<tr>
<td>Poisson</td>
<td>None</td>
<td>None</td>
<td>None</td>
</tr>
<tr>
<td>Negative binomial</td>
<td>Log-overdispersion</td>
<td><code>{lnalpha} (mean disp.)</code></td>
<td>$N(0, 10000)$</td>
</tr>
<tr>
<td>Gamma</td>
<td>Log-scale</td>
<td><code>{lnscale}</code></td>
<td>$N(0, 10000)$</td>
</tr>
</tbody>
</table>

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