

bayes: mixed — Bayesian multilevel linear regression
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Description

`bayes: mixed` fits a Bayesian multilevel linear regression to a continuous outcome; see [\[BAYES\] bayes](#) and [\[ME\] mixed](#) for details.

Quick start

Bayesian two-level linear regression of `y` on `x1` and `x2` with random intercepts by `id`, using default normal priors for regression coefficients and default inverse-gamma priors for the error variance and for the variance of random intercepts

```
bayes: mixed y x1 x2 || id:
```

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

```
bayes, normalprior(10): mixed y x1 x2 || id:
```

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)): mixed y x1 x2 || id:
```

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

```
bayes, saving(simdata) rseed(123): mixed y x1 x2 || id:
```

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): mixed y x1 x2 || id:
```

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
```

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

Menu

Statistics > Multilevel mixed-effects models > Bayesian regression > Linear regression

Syntax

```
bayes [ , bayesopts ] : mixed 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 |
|-------------------|-------------|
|-------------------|-------------|

Model

| | |
|--------------------------------|--|
| <code><u>noconstant</u></code> | suppress constant term from the fixed-effects equation |
|--------------------------------|--|

| <i>re_options</i> | Description |
|-------------------|-------------|
|-------------------|-------------|

Model

| | |
|--|--|
| <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 |
| <code><u>collinear</u></code> | keep collinear variables |

| <i>options</i> | Description |
|----------------|-------------|
|----------------|-------------|

Reporting

| | |
|-------------------------------------|---|
| <code><u>noheader</u></code> | suppress output header |
| <code><u>nogroup</u></code> | suppress table summarizing groups |
| <code><i>display_options</i></code> | control spacing, line width, and base and empty cells |
| <code><u>level</u>(#)</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: mixed`, `level()` is equivalent to `bayes, clevel(): mixed`.

For a detailed description of *options*, see [Options](#) in [\[ME\] mixed](#).

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

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

Advanced

| | |
|-------------------------------------|--|
| <code>search(search_options)</code> | control the search for feasible initial values |
| <code>corrlag(#)</code> | specify maximum autocorrelation lag; default varies |
| <code>corrctl(#)</code> | specify autocorrelation tolerance; default is <code>corrctl(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}`, error variance `{e.depvar:sigma2}`, 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 adaptive Metropolis–Hastings and Gibbs algorithms, see [BAYES] `bayesmh`. For remarks and examples specific to the `bayes` prefix, see [BAYES] `bayes`. For details about the estimation command, see [ME] `mixed`.

For a simple example of the `bayes` prefix, see *Introductory example* in [BAYES] `bayes`. For multilevel examples, see *Multilevel models* in [BAYES] `bayes`.

By default, `bayes: mixed` uses Gibbs sampling for all model parameters except the random-effects parameters. If you specify a `prior()` distribution for which Gibbs sampling is not available, `bayes: mixed` will switch to adaptive Metropolis–Hastings sampling. In general, `bayes: mixed` will try to use a more efficient Gibbs sampling for the model parameters whenever available.

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] [mixed](#) — Multilevel mixed-effects linear regression

[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](#)