**Bayes: meprobit — Bayesian multilevel probit regression**

**Description**

bayes: meprobit fits a Bayesian multilevel probit regression to a binary outcome; see [BAYES] bayes and [ME] meprobit for details.

**Quick start**

Bayesian two-level probit regression of \( y \) on \( x_1 \) and \( x_2 \) with random intercepts by \( i.d \), using default normal priors for regression coefficients and default inverse-gamma prior for the variance of random intercepts

\[
\text{bayes: meprobit} \ y \ x_1 \ x_2 \ || \ i.d: \\
\]

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

\[
\text{bayes, normalprior(10)}: \text{meprobit} \ y \ x_1 \ x_2 \ || \ i.d: \\
\]

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

\[
\text{bayes, prior(}\{y: x_1 \ x_2\}, \text{uniform(-10,10)}) \ /// \\
\text{prior(}\{y:\text{cons}\}, \text{normal}(0,10))\): \text{meprobit} \ y \ x_1 \ x_2 \ || \ i.d: \\
\]

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

\[
\text{bayes, saving(simdata) rseed(123)}: \text{meprobit} \ y \ x_1 \ x_2 \ || \ i.d: \\
\]

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

\[
\text{bayes, mcmcsize(20000) burnin(5000) dots(500)}: \text{meprobit} \ y \ x_1 \ x_2 \ || \ i.d: \\
\]

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

\[
\text{bayes, clevel(90) hpd} \\
\]

Also see Quick start in [BAYES] bayes and Quick start in [ME] meprobit.

**Menu**

Statistics > Multilevel mixed-effects models > Bayesian regression > Probit regression
Syntax

bayes [ , bayesopts ] : meprobit 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.

<table>
<thead>
<tr>
<th>fe_options</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Model</td>
<td></td>
</tr>
<tr>
<td>noconstant</td>
<td>suppress constant term from the fixed-effects equation</td>
</tr>
<tr>
<td>offset(varname)</td>
<td>include varname in model with coefficient constrained to 1</td>
</tr>
<tr>
<td>asis</td>
<td>retain perfect predictor variables</td>
</tr>
</tbody>
</table>

<table>
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<tr>
<th>re_options</th>
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</thead>
<tbody>
<tr>
<td>Model</td>
<td></td>
</tr>
<tr>
<td>covariance(vartype)</td>
<td>variance–covariance structure of the random effects; only structures independent, identity, and unstructured supported</td>
</tr>
<tr>
<td>noconstant</td>
<td>suppress constant term from the random-effects equation</td>
</tr>
</tbody>
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<tr>
<td>Model</td>
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<tr>
<td>binomial(varname</td>
<td>#)</td>
</tr>
<tr>
<td>Reporting</td>
<td></td>
</tr>
<tr>
<td>notable</td>
<td>suppress coefficient table</td>
</tr>
<tr>
<td>noheader</td>
<td>suppress output header</td>
</tr>
<tr>
<td>nogroup</td>
<td>suppress table summarizing groups</td>
</tr>
<tr>
<td>display_options</td>
<td>control spacing, line width, and base and empty cells</td>
</tr>
<tr>
<td>level(#)</td>
<td>set credible level; default is level(95)</td>
</tr>
</tbody>
</table>
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indevars may contain factor variables; see [U] 11.4.3 Factor variables.
depvar, indevars, 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: meprobit, level() is equivalent to bayes, clevel(): meprobit.
For a detailed description of options, see Options in [ME] meprobit.

bayesopts

| Description |
|-----------------|-----------------|
| **Priors**       | **Simulation**   |
| normalprior(#)   | nchains(#)      |
| *igammaprior(# #)  | mcmcsize(#)     |
| *iwishartprior(# [..]) | burnin(#)   |
| prior(priorspec)  | thinning(#)    |
| dryrun           | rseed(#)       |
|                  | exclude(paramref) |
|                  | restubs(restub1 restub2 ...) |
| **Blocking**     | **Initialization** |
| blocksize(#)     | initial(initspec) |
| *noblocking      | init#(initspec) |
| block(paramref[, blockopts]) | initall(initspec) |
|                  | nomleinitial   |
|                  | intrandom      |
|                  | initsummary    |
|                  | *noisily       |
| **Adaptation**   | control the adaptive MCMC procedure |
| adaptation(adaptopts) | scale(#)         |
|                  | covariance(cov) |

Specify standard deviation of default normal priors for regression coefficients; default is normalprior(100)
Specify shape and scale of default inverse-gamma prior for variance components; default is igammaprior(0.01 0.01)
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
Show model summary without estimation
Number of chains; default is to simulate one chain
MCMC sample size; default is mcmcsize(10000)
Burn-in period; default is burnin(2500)
Thinning interval; default is thinning(1)
Random-number seed
Specify model parameters to be excluded from the simulation results
Specify stubs for random-effects parameters for all levels
Maximum block size; default is blocksize(50)
Specify a block of model parameters; this option may be repeated
Display block summary
Do not block parameters by default
Specify initial values for model parameters with a single chain
Specify initial values for #th chain; requires nchains()
Specify initial values for all chains; requires nchains()
Suppress the use of maximum likelihood estimates as starting values
Specify random initial values
Display initial values used for simulation
Display output from the estimation command during initialization
Initial multiplier for scale factor; default is scale(2.38)
Initial proposal covariance; default is the identity matrix
Bayesian multilevel probit regression

Reporting

- `clevel(#)`: set credible interval level; default is `clevel(95)`
- `hpd`: display HPD credible intervals instead of the default equal-tailed credible intervals
- `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
- `showeffects[(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 `meprobit`
- `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.

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

Model parameters are regression coefficients `{depvar:indepvars}`, 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] meprobit.
For a simple example of the `bayes` prefix, see *Introductory example* in [BAYES] bayes. For multilevel examples, see *Multilevel models* in [BAYES] bayes.

**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] meprobit — Multilevel mixed-effects probit 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