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Description

`bayes: xtnbreg` fits a Bayesian panel-data random-effects negative binomial model to a nonnegative count outcome; see [\[BAYES\] bayes](#) and [\[XT\] xtnbreg](#) for details.

Quick start

Bayesian random-effects negative binomial model of y on x_1 and x_2 with random intercepts by `id` (after `xtsetting` on panel variable `id`), using default normal priors for regression coefficients and beta prior for the random effects, and Pareto prior for the shape parameters of the beta prior

```
bayes: xtnbreg y x1 x2
```

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

```
bayes, normalprior(10): xtnbreg y x1 x2
```

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)): xtnbreg y x1 x2
```

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

```
bayes, saving(simdata) rseed(123): xtnbreg y x1 x2
```

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): xtnbreg y x1 x2
```

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
```

Display incidence-rate ratios instead of coefficients

```
bayes: xtnbreg y x1 x2, irr
```

Display incidence-rate ratios on replay

```
bayes, irr
```

Random-effects model with exposure variable `evar`

```
bayes: xtnbreg y x1 x2, exposure(evvar)
```

Also see [Quick start](#) in [\[BAYES\] bayes](#) and [Quick start](#) in [\[XT\] xtnbreg](#).

Menu

Statistics > Longitudinal/panel data > Bayesian regression > Negative binomial regression

Syntax

bayes [, *bayesopts*] : xtnbreg *deprvar* [*indeprvars*] [*if*] [*in*] [, *options*]

<i>options</i>	Description
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Model

<u>noconstant</u>	suppress constant term
<u>exposure</u> (<i>varname_e</i>)	include $\ln(\text{varname}_e)$ in model with coefficient constrained to 1
<u>offset</u> (<i>varname_o</i>)	include <i>varname_o</i> in model with coefficient constrained to 1

Reporting

<u>irr</u>	report incidence-rate ratios
<u>display_options</u>	control spacing, line width, and base and empty cells
<u>level</u> (#)	set credible level; default is level(95)

A panel variable must be specified; see [XT] [xtset](#).

indeprvars may contain factor variables; see [U] [11.4.3 Factor variables](#).

deprvar, *indeprvars*, *varname_e*, and *varname_o* may contain time-series operators; see [U] [11.4.4 Time-series varlists](#).

bayes: xtnbreg, level() is equivalent to bayes, clevel(): xtnbreg.

For a detailed description of options, see [Options for RE/FE models](#) in [XT] [xtnbreg](#).

<i>bayesopts</i>	Description
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Priors

* <u>normalprior</u> (#)	specify standard deviation of default normal priors for regression coefficients; default is normalprior(100)
<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>nchains</u> (#)	number of chains; default is to simulate one chain
<u>mcmcsize</u> (#)	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)
<u>rseed</u> (#)	random-number seed
<u>exclude</u> (<i>paramref</i>)	specify model parameters to be excluded from the simulation results

Blocking

<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

Initialization

<u>initial</u> (<i>initspec</i>)	specify initial values for model parameters with a single chain
<u>init</u> #(<i>initspec</i>)	specify initial values for #th chain; requires nchains()
<u>initall</u> (<i>initspec</i>)	specify initial values for all chains; requires nchains()
<u>nomleinitial</u>	suppress the use of maximum likelihood estimates as starting values
<u>initransom</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

`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
`eform(string)` report exponentiated coefficients and, optionally, label as *string*
`remargl` compute log marginal-likelihood; suppressed by default
`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
`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 `nodots`
`dots(#[, every(#)])` display dots as simulation is performed
`[no]show(paramref)` specify model parameters to be excluded from or included in the output
`showreflects(reref)` specify that all or a subset of random-effects parameters be included in the output
`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}`, random effects `{U[panelvar]}` or simply `{U}`, and shape parameters `{r}` and `{s}` for the beta prior of `{U}`; also see *Methods and formulas*. 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 [XT] xtnbreg.

For a simple example of the bayes prefix, see *Introductory example* in [BAYES] [bayes](#). Also see *Panel-data models* in [BAYES] [bayes](#).

Stored results

See *Stored results* in [BAYES] [bayes](#). In addition, bayes: xtnbreg also stores the following results:

Macros	
e(ivar)	variable denoting groups
e(redistrib)	distribution of random effects

Methods and formulas

Bayesian random-effects negative binomial models are based on random-effects negative binomial models described in *Methods and formulas* of [XT] [xtnbreg](#).

Let y_{it} be the count for the t th observation in the i th group. We assume $y_{it} \mid \gamma_{it} \sim \text{Poisson}(\gamma_{it})$, where $\gamma_{it} \mid u_i \sim \text{gamma}\{\lambda_{it}, (1 - u_i)/u_i\}$ with $\lambda_{it} = \exp(\mathbf{x}_{it}\beta + \text{offset}_{it})$ and u_i is a dispersion-control parameter that varies randomly across groups. The likelihood of the model is thus

$$\Pr(Y_{it} = y_{it} \mid \mathbf{x}_{it}, u_i) = \frac{\Gamma(\lambda_{it} + y_{it})}{\Gamma(\lambda_{it})\Gamma(y_{it} + 1)} u_i^{\lambda_{it}} (1 - u_i)^{y_{it}}$$

We further assume that random-effects dispersion parameters u_i 's are a priori independent and follow beta distribution with shape parameters r and s , $u_i \sim \text{Beta}(r, s)$. The hyperprior for the shape parameters is chosen so that the joint distribution of the mean $r/(r + s)$ and inverse square-root of the sample size $(r + s)$ of the beta distribution is uniform, $\{r/(r + s), (r + s)^{-0.5}\} \sim 1$; see [Gelman et al. \(2014, sec. 5.3\)](#). This choice leads to a diffused distribution for (r, s) with a density proportional to $(r + s)^{-2.5}$, which is a Pareto-type distribution.

bayes: xtnbreg uses the default initial value of 0.5 for the random effects u_i 's.

See *Methods and formulas* in [BAYES] [bayesmh](#).

Reference

Gelman, A., J. B. Carlin, H. S. Stern, D. B. Dunson, A. Vehtari, and D. B. Rubin. 2014. *Bayesian Data Analysis*. 3rd ed. Boca Raton, FL: Chapman and Hall/CRC.

Also see

[BAYES] [bayes](#) — Bayesian regression models using the bayes prefix

[XT] [xtnbreg](#) — Fixed-effects, random-effects, & population-averaged negative binomial models

[BAYES] [Bayesian postestimation](#) — Postestimation tools after Bayesian estimation

[BAYES] [Bayesian estimation](#) — Bayesian estimation commands

[BAYES] [Bayesian commands](#) — Introduction to commands for Bayesian analysis

[BAYES] [Intro](#) — Introduction to Bayesian analysis

[BAYES] [Glossary](#)

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