**bayes: mestreg — Bayesian multilevel parametric survival models**

### Description

`bayes: mestreg` fits a Bayesian multilevel parametric survival model to a survival-time outcome; see [BAYES] `bayes` and [ME] `mestreg` for details.

### Quick start

Bayesian two-level Weibull survival model of `stset` survival-time outcome on `x1` and `x2` with random intercepts by `id`, using default normal priors for regression coefficients and log-ancillary parameters and default inverse-gamma prior for the variance of random intercepts

```
bayes: mestreg x1 x2 || id:, distribution(weibull)
```

Use a standard deviation of 10 instead of 100 for the default normal priors
```
bayes, normalprior(10): mestreg x1 x2 || id:, distribution(weibull)
```

Use uniform priors for the slopes and a normal prior for the intercept
```
bayes, prior({_t: x1 x2}, uniform(-10,10)) ///
   prior({_t:_cons}, normal(0,10)): ///
   mestreg x1 x2 || id:, distribution(weibull)
```

Save simulation results to `simdata.dta`, and use a random-number seed for reproducibility
```
bayes, saving(simdata) rseed(123): ///
   mestreg x1 x2 || id:, distribution(weibull)
```

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): ///
   mestreg x1 x2 || id:, distribution(weibull)
```

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
```

Use accelerated failure-time metric instead of proportional-hazards parameterization, and display time ratios instead of coefficients
```
bayes, tratio: mestreg x1 x2 || id:, distribution(weibull) time
```

Display time ratios on replay
```
bayes, tratio
```

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

### Menu

Statistics > Multilevel mixed-effects models > Bayesian regression > Parametric survival regression
Syntax

```
bayes [, bayesopts] : mestreg fe_equation
   [ || re_equation ] [ || re_equation ... ], distribution(distname) [ 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.

### fe_options

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>suppress constant term from the fixed-effects equation</td>
</tr>
<tr>
<td>include <code>varname</code> in model with coefficient constrained to 1</td>
</tr>
</tbody>
</table>

### re_options

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>variance–covariance structure of the random effects; only structures <code>independent</code>, <code>identity</code>, and <code>unstructured</code> supported</td>
</tr>
<tr>
<td>suppress constant term from the random-effects equation</td>
</tr>
</tbody>
</table>

### options

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>specify survival distribution</td>
</tr>
<tr>
<td>use accelerated failure-time metric</td>
</tr>
<tr>
<td>do not report hazard ratios</td>
</tr>
<tr>
<td>report time ratios</td>
</tr>
<tr>
<td>do not show <code>st</code> setting information</td>
</tr>
<tr>
<td>suppress coefficient table</td>
</tr>
<tr>
<td>suppress output header</td>
</tr>
<tr>
<td>suppress table summarizing groups</td>
</tr>
<tr>
<td>control spacing, line width, and base and empty cells</td>
</tr>
<tr>
<td>set credible level; default is <code>level(95)</code></td>
</tr>
</tbody>
</table>
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*distribution(distname) is required.
You must stset your data before using bayes: mestreg; see [ST] stset.
 indepvars may contain factor variables; see [U] 11.4.3 Factor variables.
 fweights are allowed; see [U] 11.1.6 weight.
 bayes: mestreg, level() is equivalent to bayes, clevel(): mestreg.
 For a detailed description of options, see Options in [ME] mestreg.

bayesopts

<table>
<thead>
<tr>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Priors</strong></td>
</tr>
<tr>
<td>normalprior(#)</td>
</tr>
<tr>
<td>igammaprior(# #)</td>
</tr>
<tr>
<td>iwishartprior(# [...]</td>
</tr>
<tr>
<td>prior(priorspec)</td>
</tr>
<tr>
<td>dryrun</td>
</tr>
<tr>
<td>Simulation</td>
</tr>
<tr>
<td>nchains(#)</td>
</tr>
<tr>
<td>mcmcsize(#)</td>
</tr>
<tr>
<td>burnin(#)</td>
</tr>
<tr>
<td>thinning(#)</td>
</tr>
<tr>
<td>rseed(#)</td>
</tr>
<tr>
<td>exclude(paramref)</td>
</tr>
<tr>
<td>restubs(restub1 restub2 ...)</td>
</tr>
<tr>
<td>Blocking</td>
</tr>
<tr>
<td>blocksize(#)</td>
</tr>
<tr>
<td>block(paramref[, blockopts])</td>
</tr>
<tr>
<td>blocksummary</td>
</tr>
<tr>
<td>noblocking</td>
</tr>
<tr>
<td>Initialization</td>
</tr>
<tr>
<td>initial(initspec)</td>
</tr>
<tr>
<td>init#(initspec)</td>
</tr>
<tr>
<td>initall(initspec)</td>
</tr>
<tr>
<td>nomleinitial</td>
</tr>
<tr>
<td>initrandom</td>
</tr>
<tr>
<td>initsummary</td>
</tr>
<tr>
<td>noisily</td>
</tr>
<tr>
<td>Adaptation</td>
</tr>
<tr>
<td>adaptation(adaptopts)</td>
</tr>
<tr>
<td>scale(#)</td>
</tr>
<tr>
<td>covariance(cov)</td>
</tr>
</tbody>
</table>
Report

\texttt{clevel(\#)} 
\hspace{1em} set credible interval level; default is clevel(95)

\texttt{hpd} 
\hspace{1em} display HPD credible intervals instead of the default equal-tailed credible intervals

*\texttt{nohr} 
\hspace{1em} do not report hazard ratios

*\texttt{ratio} 
\hspace{1em} report time ratios; requires option time with \texttt{mestreg}

\texttt{eform([\textit{string}])} 
\hspace{1em} report exponentiated coefficients and, optionally, label as \textit{string}

\texttt{remargl} 
\hspace{1em} compute log marginal-likelihood

\texttt{batch(\#)} 
\hspace{1em} specify length of block for batch-means calculations; default is batch(0)

\texttt{saving(filename[, replace])} 
\hspace{1em} save simulation results to \textit{filename.dta}

\texttt{nomodelsummary} 
\hspace{1em} suppress model summary

\texttt{nomesummary} 
\hspace{1em} suppress multilevel-structure summary

\texttt{chainsdetail} 
\hspace{1em} display detailed simulation summary for each chain

[\texttt{no]} \texttt{dots} 
\hspace{1em} suppress dots or display dots every 100 iterations and iteration numbers every 1,000 iterations; default is dots

\texttt{dots(\#[, every(\#)])} 
\hspace{1em} display dots as simulation is performed

[\texttt{no]} \texttt{show(paramref)} 
\hspace{1em} specify model parameters to be excluded from or included in the output

\texttt{showeffects([\textit{reref}])} 
\hspace{1em} specify that all or a subset of random-effects parameters be included in the output

\texttt{melabel} 
\hspace{1em} display estimation table using the same row labels as \texttt{mestreg}

\texttt{nogroup} 
\hspace{1em} suppress table summarizing groups

\texttt{notable} 
\hspace{1em} suppress estimation table

\texttt{noheader} 
\hspace{1em} suppress output header

\texttt{title(string)} 
\hspace{1em} display \textit{string} as title above the table of parameter estimates

\texttt{display_options} 
\hspace{1em} control spacing, line width, and base and empty cells

Advanced

\texttt{search(search_options)} 
\hspace{1em} control the search for feasible initial values

\texttt{corrlag(\#)} 
\hspace{1em} specify maximum autocorrelation lag; default varies

\texttt{corrtol(\#)} 
\hspace{1em} specify autocorrelation tolerance; default is corrtol(0.01)

*Starred options are specific to the \texttt{bayes} prefix; other options are common between \texttt{bayes} and \texttt{bayesmh}.

Options prior() and block() may be repeated.

\texttt{priorspec} and \texttt{paramref} are defined in [BAYES] \texttt{bayesmh}.

\texttt{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 \{\textit{depvar}:\textit{indepvars}\}, ancillary parameters as described in Ancillary model parameters, random effects \{\textit{rename}\}, and either variance components \{\textit{rename}:\textit{sigma2}\} or, if option covariance(unstructured) is specified, matrix parameter \{\texttt{restub}:\texttt{Sigma},\texttt{matrix}\}; see Likelihood model in [BAYES] \texttt{bayes} for how \texttt{rename}s and \texttt{restub} are defined. Use the dryrun option to see the definitions of model parameters prior to estimation.

For a detailed description of \texttt{bayesopts}, see Options in [BAYES] \texttt{bayes}.

\section*{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] \texttt{bayesmh}. For
remains and examples specific to the \texttt{bayes} prefix, see \cite{bays}. For details about the estimation command, see \cite{ME mestreg}.

For a simple example of the \texttt{bayes} prefix, see \textit{Introductory example} in \cite{bays}. For multilevel examples, see \textit{Multilevel models} in \cite{bays}.

\section*{Ancillary model parameters}

In addition to regression coefficients \{\texttt{t:varlist}\}, \texttt{bayes: mestreg} defines ancillary parameters that depend on the chosen survival model; see table 1 below. Positive ancillary parameters are transformed to be defined on the whole real line. All ancillary parameters are assigned default normal priors with zero mean and variance of 10,000.

\begin{table}[h]
\centering
\begin{tabular}{lll}
\hline
Distribution   & Ancillary parameters & Transformed model parameters \\
\hline
Exponential    & None                 & None                \\
Weibull        & \(p\)                & \{ln\_p\}           \\
Lognormal      & \(\sigma\)           & \{ln\_sigma\}       \\
Loglogistic    & \(\gamma\)           & \{ln\_gamma\}       \\
Gamma          & \(s\)                & \{ln\_scale\}       \\
\hline
\end{tabular}
\caption{Ancillary model parameters defined by \texttt{bayes: mestreg}}
\end{table}

Use the \texttt{dryrun} option with the \texttt{bayes} prefix to see the definitions of model parameters prior to estimation.

\section*{Stored results}

See \textit{Stored results} in \cite{bays}.

\section*{Methods and formulas}

See \textit{Methods and formulas} in \cite{baysmh}.

\section*{Also see}

\cite{bays} — Bayesian regression models using the bayes prefix

\cite{ME mestreg} — Multilevel mixed-effects parametric survival models

\cite{bays} \texttt{Bayesian postestimation} — Postestimation tools for bayesmh and the bayes prefix

\cite{bays} \texttt{Bayesian estimation} — Bayesian estimation commands

\cite{bays} \texttt{Bayesian commands} — Introduction to commands for Bayesian analysis

\cite{bays} \texttt{Intro} — Introduction to Bayesian analysis

\cite{bays} \texttt{Glossary}