Title

runmixregs — Run the MIXREGLS mixed-effects location scale software from within Stata

Syntax

runmixregs depvar [varlist] [if] [in] [, options]

where varlist specifies variables in the mean function.

options

<table>
<thead>
<tr>
<th>Description</th>
<th>Model</th>
</tr>
</thead>
<tbody>
<tr>
<td>suppress constant term in the mean function</td>
<td>noconstant</td>
</tr>
<tr>
<td>specify variables in between-group variance function</td>
<td>between(varlist [, noconstant])</td>
</tr>
<tr>
<td>specify variables in within-group variance function</td>
<td>within(varlist [, noconstant])</td>
</tr>
<tr>
<td>specify the group-level association between the (log of the) within-group variance and the random-location effects; default is association(linear)</td>
<td>association(ATYPE)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Random effects/Residuals</th>
</tr>
</thead>
<tbody>
<tr>
<td>retrieve standardized random-location and random-scale effects</td>
<td>reffects(newvar1 newvar2)</td>
</tr>
<tr>
<td>retrieve standardized residual errors</td>
<td>residuals(newvar)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Integration</th>
</tr>
</thead>
<tbody>
<tr>
<td>do not perform adaptive Gaussian quadrature</td>
<td>noadapt</td>
</tr>
<tr>
<td>set the number of integration (quadrature) points; default is intpoints(11)</td>
<td>intpoints(#)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Maximization</th>
</tr>
</thead>
<tbody>
<tr>
<td>maximum number of iterations; default is iterate(200)</td>
<td>iterate(#)</td>
</tr>
<tr>
<td>tolerance; default is tolerance(0.0005)</td>
<td>tolerance(#)</td>
</tr>
<tr>
<td>standardize all covariates</td>
<td>standardize</td>
</tr>
<tr>
<td>initial value for ridge; default is ridgein(0)</td>
<td>ridgein(#)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Description</th>
<th>Reporting</th>
</tr>
</thead>
<tbody>
<tr>
<td>set confidence level; default is level(95)</td>
<td>level(#)</td>
</tr>
<tr>
<td>control column formats, row spacing, line width, and display of omitted variables and base and empty cells</td>
<td>display options</td>
</tr>
<tr>
<td>suppress table header</td>
<td>noheader</td>
</tr>
<tr>
<td>suppress coefficient table</td>
<td>notable</td>
</tr>
<tr>
<td>display legend instead of statistics</td>
<td>coeflegend</td>
</tr>
</tbody>
</table>

| Description                  | |
|------------------------------| atype |
| none                         | none |
| linear; the default          | linear |
| quadratic                    | quadratic |

A panel variable must be specified. Use xtset.
runmixregrs runs the MIXREGLS mixed-effects location scale software (Hedeker and Nordgren 2013) from within Stata.

The mixed-effects location scale model extends the standard two-level random-intercept mixed-effects model for continuous responses (xtreg, mle) in three ways.

(1) The (log of the) within- and between-group variances are further modeled as functions of the covariates.

(2) A new random effect, referred to as the random-scale effect, is then entered into the within-group variance function to account for any unexplained group differences in the residual variance. The existing random-intercept effect is now referred to as the random-location effect.

(3) A group-level association between the location and the scale may be allowed for by entering the random-location effect into the within-group variance function using either a linear or quadratic functional form. The regression coefficients of these linear and quadratic terms are then estimated.

The distributions of the random-location and random-scale effects are assumed to be Gaussian.

Options

Model

noconstant; see[R] estimation options.

between(varlist [, noconstant]) specifies the variables in the between-group variance function.

within(varlist [, noconstant]) specifies the variables in the within-group variance function.

association(atype), where atype is

none | linear | quadratic

specifies the group-level association between the (log of the) within-group variance and the random-location effects. The default is association(linear).

Random effects/Residuals

reffects(newvar1 newvar2) retrieves the best linear unbiased predictions (BLUPs) of the standardized random effects from MIXREGLS. BLUPs are also known as empirical Bayes estimates. The standardized random-location effects are placed in newvar1 while the standardized random-scale effects are placed in newvar2. The associated standard errors are placed in newvar1_se and newvar2_se.

residuals(newvar) retrieves the standardized residual errors from MIXREGLS.

Integration

noadapt prevents MIXREGLS from using adaptive Gaussian quadrature. MIXREGLS will use ordinary Gaussian quadrature instead.
The mixed-effects location scale model fitted by MIXREGLS consists of three functions

1. the mean function,

2. the between-group variance function,

3. the within-group variance function.

These three functions can be written as

\[ y_{ij} = b_1 x_{1ij} + \sigma_u \theta_j + e_{ij}, \quad i=1, \ldots, n_j; \quad j=1, \ldots, J, \]

\[ \log(\sigma_u) = b_2 x_{2ij}, \]

...
\[
\log(\sigma^2_{e_ij}) = b_3 \cdot x_{3ij} + a_l \cdot \theta_{1j} + a_q \cdot \theta^2_{1j} + 
\sigma_v \cdot \theta_{2j},
\]

where

\[
\begin{align*}
\theta_{1j} &\sim N(0,1), \\
\theta_{2j} &\sim N(0,1), \\
e_{ij} &\sim N(0,\sigma^2_{e_ij}),
\end{align*}
\]

and

\[y_{ij}\] is the continuous response variable,
\[x_{1ij}, x_{2ij}\text{ and } x_{3ij}\text{ are vectors of observation- and group-level covariates,} \]
\[b_1, b_2\text{ and } b_3\text{ are vectors of parameters to be estimated,} \]
\[\theta_{1j}\text{ are the unobserved standardized random-location effects,} \]
\[\theta_{2j}\text{ are the unobserved standardized random-scale effects,} \]
\[a_l\text{ and } a_q\text{ are scalar parameters to be estimated,} \]
\[e_{ij}\text{ are the observation-specific errors.} \]

See Hedeker and Nordgren 2013 for further details on the mixed-effects location scale model.

**Remarks on getting runmixregls working for the first time**

*runmixregls* can be installed from the Statistical Software Components (SSC) archive by typing the following from a net-aware version of Stata:

```
.ssc install runmixregls
```

If you have already installed *runmixregls* from the SSC, you can check that you are using the latest version by typing the following command:

```
.adoupdate runmixregls
```

**Remarks on MIXREGLS estimation**

*MIXREGLS* uses maximum likelihood estimation, utilizing both the EM algorithm and a Newton-Raphson solution. Because the log likelihood for this model has no closed form, it is approximated by adaptive Gaussian quadrature. Estimation of the random effects is accomplished using empirical Bayes methods. The full model is estimated in three sequential stages:

1. Standard random-intercept model + between-group variance function regression coefficients
2. Stage 1 model + within-group variance function regression coefficients
3. Stage 2 model + group-level association between the (log of the) within-group variance and the random-location effects + random-scale effects
Prior to Stage 1, 20 iterations are performed of the EM algorithm to estimate the parameters of a standard random-intercept model (regression coefficients, between-group variance, within-group variance, and random-location effects). These estimates are then used as starting values for Stage 1. Estimates at each stage are used as starting values for the next stage, which improves the convergence of the final model. This also provides a way of assessing the statistical significance of the additional parameters in each stage via likelihood-ratio tests. The results of each stage as well as these likelihood-ratio tests are provided in the saved results.

See Hedeker and Nordgren (2013) for further details on the MIXREGLS estimation.

Remarks on runmixregr output

The runmixregr output displays five different sets of parameters:

Mean: Mean function regression coefficients

Between: Between-group variance function regression coefficients
(log scale)

Within: Within-group variance function regression coefficients
(log scale)

Association: Group-level association parameters between the (log of the) within-group function and the random-location effects

Scale: Random-scale standard deviation

Example: Replicate Hedeker and Nordgren (2013) (pages 10-18)

Load the data

```
. use http://www.bristol.ac.uk/csm/media/runmixregrs/resby, clear
```

Recode missing values in hamdep from -9 to Stata system missing

```
. recode hamdep (-9 = .)
```

Declare panel variable to be id

```
. xtset id
```

Fit the mixed-effects location scale model

```
. runmixregr hamdep week endog endweek, between(endog) within(week endog)
```

Refit the model, this time retrieving the BLUPs of the standardized random-location and random-scale effects, and their associated standard errors.

```
. runmixregr hamdep week endog endweek, between(endog) within(week endog) reffects(theta1 theta2)
```

Examine a scatter plot of the BLUPs of the standardized random-scale effects against the standardized random-location effects

```
. scatter theta2 theta1
```

Refit the model removing the group-level linear association between the (log of the) within-group variance and the intercept

```
. runmixregr hamdep week endog endweek, between(endog) within(week endog) association(none)
```

Saved results

runmixregr saves the following in e():

Scalars
Similarly, please also cite the MIXREGLS software:


Similarly, please also cite the MIXREGLS software:

\textit{runmiregls} is not an official Stata command. It is a free contribution to the research community, like a paper. Please cite it as such:

---

\textbf{Citation of runmixregrls and MIXREGLS}

runmiregls is not an official Stata command. It is a free contribution to the research community, like a paper. Please cite it as such:


Similarly, please also cite the MIXREGLS software:

**Authors**

George Leckie  
Centre for Multilevel Modelling  
University of Bristol  
g.leckie@bristol.ac.uk  
[http://www.bristol.ac.uk/cmm/team/leckie.html](http://www.bristol.ac.uk/cmm/team/leckie.html)

Chris Charlton  
Centre for Multilevel Modelling  
University of Bristol

**Acknowledgments**

The development of this command was funded under the LEMMA3 project, a node of the UK Economic and Social Research Council's National Centre for Research Methods (grant number RES-576-25-0035).

**Disclaimer**

*runmixregrs* comes with no warranty.

**References**


**Also see**

Manual: [XT] *xtreg* [ME] *mixed*

Online: [XT] *xtreg*, [ME] *mixed*, *runmlwin*, *gllamm*