Title

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mepoisson postestimation — Postestimation tools for mepoisson

Postestimation commands

The following postestimation command is of special interest after `mepoisson`:

Command	Description
`estat group`	summarize the composition of the nested groups
`estat sd`	display variance components as standard deviations and correlations

The following standard postestimation commands are also available:

Command	Description
`contrast`	contrasts and ANOVA-style joint tests of estimates
`estat ic`	Akaike's, consistent Akaike's, corrected Akaike's, and Schwarz's Bayesian information criteria (AIC, CAIC, AICc, and BIC)
`estat summarize`	summary statistics for the estimation sample
`estat vce`	variance–covariance matrix of the estimators (VCE)
`estat (svy)`	postestimation statistics for survey data
`estimates`	cataloging estimation results
`etable`	table of estimation results
* `hausman`	Hausman's specification test
`lincom`	point estimates, standard errors, testing, and inference for linear combinations of coefficients
* `lrtest`	likelihood-ratio test
`margins`	marginal means, predictive margins, marginal effects, and average marginal effects
`marginsplot`	graph the results from margins (profile plots, interaction plots, etc.)
`nlcom`	point estimates, standard errors, testing, and inference for nonlinear combinations of coefficients
`predict`	means, probabilities, densities, REs, residuals, etc.
`predictnl`	point estimates, standard errors, testing, and inference for generalized predictions
`pwcompare`	pairwise comparisons of estimates
`test`	Wald tests of simple and composite linear hypotheses
`testnl`	Wald tests of nonlinear hypotheses

*`hausman` and `lrtest` are not appropriate with `svy` estimation results.

predict

Description for predict

`predict` creates a new variable containing predictions such as mean responses; linear predictions; density and distribution functions; standard errors; and Pearson, deviance, and Anscombe residuals.

Menu for predict

Statistics > Postestimation

Syntax for predict

Syntax for obtaining predictions of the outcome and other statistics

```
predict [type] {stub*|newvarlist} [if] [in] [, statistic options]
```

Syntax for obtaining estimated random effects and their standard errors

```
predict [type] {stub*|newvarlist} [if] [in], reffects [re_options]
```

Syntax for obtaining ML scores

```
predict [type] {stub*|newvarlist} [if] [in], scores
```

statistic	Description
Main	
`mu`	mean response; the default
`eta`	fitted linear predictor
`xb`	linear predictor for the fixed portion of the model only
`stdp`	standard error of the fixed-portion linear prediction
`density`	predicted density function
`distribution`	predicted distribution function
`pearson`	Pearson residuals
`deviance`	deviance residuals
`anscombe`	Anscombe residuals

These statistics are available both in and out of sample; type `predict ... if e(sample) ...` if wanted only for the estimation sample.

options	Description
Main	
`conditional(`*ctype*`)`	compute *statistic* conditional on estimated random effects; default is `conditional(ebmeans)`
`marginal`	compute *statistic* marginally with respect to the random effects
`nooffset`	make calculation ignoring offset or exposure
Integration	
int_options	integration options

`pearson`, `deviance`, `anscombe` may not be combined with `marginal`.

ctype	Description
`ebmeans`	empirical Bayes means of random effects; the default
`ebmodes`	empirical Bayes modes of random effects
`fixedonly`	prediction for the fixed portion of the model only

re_options	Description
Main	
`ebmeans`	use empirical Bayes means of random effects; the default
`ebmodes`	use empirical Bayes modes of random effects
`reses(`*stub*`*` | *newvarlist*`)`	calculate standard errors of empirical Bayes estimates
Integration	
int_options	integration options

int_options	Description
`intpoints(#)`	use # quadrature points to compute marginal predictions and empirical Bayes means
`iterate(#)`	set maximum number of iterations in computing statistics involving empirical Bayes estimators
`tolerance(#)`	set convergence tolerance for computing statistics involving empirical Bayes estimators

Options for predict

Main

`mu`, the default, calculates the predicted mean, that is, the predicted number of events.

`eta`, `xb`, `stdp`, `density`, `distribution`, `pearson`, `deviance`, `anscombe`, `scores`, `conditional()`, `marginal`, and `nooffset`; see [ME] **meglm postestimation**.

`reffects`, `ebmeans`, `ebmodes`, and `reses()`; see [ME] **meglm postestimation**.

Integration

`intpoints()`, `iterate()`, and `tolerance()`; see [ME] **meglm postestimation**.

margins

Description for margins

`margins` estimates margins of response for mean responses and linear predictions.

Menu for margins

Statistics > Postestimation

Syntax for margins

`margins` [*marginlist*] [`,` *options*]

`margins` [*marginlist*] `,` `predict(`*statistic* ...`)` [`predict(`*statistic* ...`)` ...] [*options*]

statistic	Description
`mu`	mean response; the default
`eta`	fitted linear predictor
`xb`	linear predictor for the fixed portion of the model only
`stdp`	not allowed with `margins`
`density`	not allowed with `margins`
`distribution`	not allowed with `margins`
`pearson`	not allowed with `margins`
`deviance`	not allowed with `margins`
`anscombe`	not allowed with `margins`
`reffects`	not allowed with `margins`
`scores`	not allowed with `margins`

Options `conditional(ebmeans)` and `conditional(ebmodes)` are not allowed with `margins`.

Option `marginal` is assumed where applicable if `conditional(fixedonly)` is not specified.

Statistics not allowed with `margins` are functions of stochastic quantities other than `e(b)`.

For the full syntax, see [R] **margins**.

Remarks and examples

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Various predictions, statistics, and diagnostic measures are available after fitting a mixed-effects Poisson model with `mepoisson`. For the most part, calculation centers around obtaining estimates of the subject/group-specific random effects. Random effects are not estimated when the model is fit but instead need to be predicted after estimation.

Here we show a short example of predicted counts and predicted random effects; refer to [ME] **meglm postestimation** for additional examples applicable to mixed-effects generalized linear models.

Example 1: Predicting counts and random effects

In example 2 of [ME] **mepoisson**, we modeled the number of observed epileptic seizures as a function of treatment with the drug progabide and other covariates,

$$\log(\mu_{ij}) = \beta_0 + \beta_1\texttt{treat}_{ij} + \beta_2\texttt{lbas}_{ij} + \beta_3\texttt{lbas\_trt}_{ij} + \beta_4\texttt{lage}_{ij} + \beta_5\texttt{visit}_{ij} + u_j + v_j\texttt{visit}_{ij}$$

where (u_j, v_j) are bivariate normal with 0 mean and variance–covariance matrix

$$\mathbf{\Sigma} = \text{Var}\begin{bmatrix} u_j \\ v_j \end{bmatrix} = \begin{bmatrix} \sigma_u^2 & \sigma_{uv} \\ \sigma_{uv} & \sigma_v^2 \end{bmatrix}$$

```
. use https://www.stata-press.com/data/r18/epilepsy
(Epilepsy data; progabide drug treatment)
. mepoisson seizures treat lbas lbas_trt lage visit || subject: visit,
> cov(unstructured) intpoints(9)
```

(*iteration log omitted*)

```
Mixed-effects Poisson regression                Number of obs     =        236
Group variable: subject                         Number of groups  =         59
                                                Obs per group:
                                                              min =          4
                                                              avg =        4.0
                                                              max =          4
Integration method: mvaghermite                 Integration pts.  =          9
                                                Wald chi2(5)      =     115.56
Log likelihood = -655.68103                     Prob > chi2       =     0.0000
```

seizures	Coefficient	Std. err.	z	P>|z|	[95% conf.	interval]
treat	-.9286592	.4021715	-2.31	0.021	-1.716901	-.1404175
lbas	.8849762	.1312535	6.74	0.000	.627724	1.142228
lbas_trt	.3379759	.2044471	1.65	0.098	-.062733	.7386849
lage	.4767192	.3536276	1.35	0.178	-.2163781	1.169817
visit	-.2664098	.1647098	-1.62	0.106	-.5892352	.0564156
_cons	2.099555	.2203749	9.53	0.000	1.667629	2.531482
subject						
var(visit)	.5314803	.229385			.2280928	1.238405
var(_cons)	.2514923	.0587902			.1590534	.3976549
subject						
cov(visit, _cons)	.0028715	.0887037	0.03	0.974	-.1709846	.1767276

```
LR test vs. Poisson model: chi2(3) = 324.54                   Prob > chi2 = 0.0000
Note: LR test is conservative and provided only for reference.
```

The purpose of this model was to allow subject-specific linear log trends over each subject's four doctor visits, after adjusting for the other covariates. The intercepts of these lines are distributed $N(\beta_0, \sigma_u^2)$, and the slopes are distributed $N(\beta_5, \sigma_v^2)$, based on the fixed effects and assumed distribution of the random effects.

We can use `predict` to obtain estimates of the random effects u_j and v_j and combine these with our estimates of β_0 and β_5 to obtain the intercepts and slopes of the linear log trends.

```
. predict re_visit re_cons, reffects
(calculating posterior means of random effects)
(using 9 quadrature points)
. generate b1 = _b[visit] + re_visit
. generate b0 = _b[_cons] + re_cons
. by subject, sort: generate tolist = _n==1
. list subject treat b1 b0 if tolist & (subject <=5 | subject >=55)
```

	subject	treat	b1	b0
1.	1	Placebo	-.428854	2.13539
5.	2	Placebo	-.2731013	2.149744
9.	3	Placebo	.0022089	2.417506
13.	4	Placebo	-.3197094	2.238224
17.	5	Placebo	.6082718	2.110739
217.	55	Progabide	-.2308834	2.282539
221.	56	Progabide	.2912798	3.19678
225.	57	Progabide	-.4828764	1.423153
229.	58	Progabide	-.2519466	1.131373
233.	59	Progabide	-.1269573	2.171541

We list these slopes (`b1`) and intercepts (`b0`) for five control subjects and five subjects on the treatment.

```
. count if tolist & treat
  31
. count if tolist & treat & b1 < 0
  25
. count if tolist & !treat
  28
. count if tolist & !treat & b1 < 0
  20
```

We also find that 25 of the 31 subjects taking progabide were estimated to have a downward trend in seizures over their four doctor visits, compared with 20 of the 28 control subjects.

We also obtain predictions for number of seizures, and unless we specify the `conditional(fixedonly)` option, these predictions will incorporate the estimated subject-specific random effects.

```
. predict n
(option mu assumed)
(predictions based on fixed effects and posterior means of random effects)
(using 9 quadrature points)
```

```
. list subject treat visit seizures n if subject <= 2 | subject >= 58, sep(0)
```

	subject	treat	visit	seizures	n
1.	1	Placebo	-.3	5	3.775774
2.	1	Placebo	-.1	3	3.465422
3.	1	Placebo	.1	3	3.18058
4.	1	Placebo	.3	3	2.919151
5.	2	Placebo	-.3	3	3.598805
6.	2	Placebo	-.1	5	3.40751
7.	2	Placebo	.1	3	3.226382
8.	2	Placebo	.3	3	3.054883
229.	58	Progabide	-.3	0	.9611137
230.	58	Progabide	-.1	0	.9138838
231.	58	Progabide	.1	0	.8689747
232.	58	Progabide	.3	0	.8262726
233.	59	Progabide	-.3	1	2.40652
234.	59	Progabide	-.1	4	2.346184
235.	59	Progabide	.1	3	2.287361
236.	59	Progabide	.3	2	2.230013

Methods and formulas

Methods and formulas for predicting random effects and other statistics are given in *Methods and formulas* of [ME] **meglm postestimation**.

Also see

[ME] **mepoisson** — Multilevel mixed-effects Poisson regression

[ME] **meglm postestimation** — Postestimation tools for meglm

[U] **20 Estimation and postestimation commands**