meintreg postestimation — Postestimation tools for meintreg

Postestimation commands

The following postestimation commands are of special interest after meintreg:

Command	Description
estat group	summarize the composition of the nested groups
estat icc	estimate intraclass correlations
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 linear predictions, standard errors, probabilities, and expected values.

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	
`eta`	fitted linear predictor; the default
`xb`	linear predictor for the fixed portion of the model only
`stdp`	standard error of the fixed-portion linear prediction
`pr(`a`,`b`)`	$\Pr(a < y < b)$
`e(`a`,`b`)`	$E(y \mid a < y < b)$
`ystar(`a`,`b`)`	$E(y^*)$, $y^* = \max\{a, \min(y, b)\}$

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

where a and b may be numbers or variables; a missing ($a \geq .$) means $-\infty$, and b missing ($b \geq .$) means $+\infty$; see [U] 12.2.1 Missing values.

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

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

eta, the default, calculates the fitted linear prediction.

pr(*a*,*b*) calculates estimates of $\Pr(a < y < b)$, which is the probability that y would be observed in the interval (a, b).

a and *b* may be specified as numbers or variable names; *lb* and *ub* are variable names;
pr(20,30) calculates $\Pr(20 < y < 30)$;
pr(*lb*,*ub*) calculates $\Pr(lb < y < ub)$; and
pr(20,*ub*) calculates $\Pr(20 < y < ub)$.

a missing ($a \geq .$) means $-\infty$; pr(.,30) calculates $\Pr(-\infty < y < 30)$;
pr(*lb*,30) calculates $\Pr(-\infty < y < 30)$ in observations for which $lb \geq .$
(and calculates $\Pr(lb < y < 30)$ elsewhere).

b missing ($b \geq .$) means $+\infty$; `pr(20,.)` calculates $\Pr(+\infty > y > 20)$; `pr(20,`*ub*`)` calculates $\Pr(+\infty > y > 20)$ in observations for which $ub \geq .$ (and calculates $\Pr(20 < y < ub)$ elsewhere).

`e(`*a*`,`*b*`)` calculates estimates of $E(y \mid a < y < b)$, which is the expected value of y conditional on y being in the interval (a,b), meaning that y is truncated. a and b are specified as they are for `pr()`.

`ystar(`*a*`,`*b*`)` calculates estimates of $E(y^*)$, where $y^* = a$ if $y \leq a$, $y^* = b$ if $y \geq b$, and $y^* = y$ otherwise, meaning that y^* is the censored version of y. a and b are specified as they are for `pr()`.

`xb`, `stdp`, `scores`, `conditional()`, `marginal`, and `nooffset`; see [ME] **meglm postestimation**.

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

Integration

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

margins

Description for margins

`margins` estimates margins of response for linear predictions, probabilities, and expected values.

Menu for margins

Statistics > Postestimation

Syntax for margins

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

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

statistic	Description
`eta`	fitted linear predictor; the default
`xb`	linear predictor for the fixed portion of the model only
`pr(`*a*`,`*b*`)`	$\Pr(a < y < b)$
`e(`*a*`,`*b*`)`	$E(y \mid a < y < b)$
`ystar(`*a*`,`*b*`)`	$E(y^*)$, $y^* = \max\{a, \min(y,b)\}$
`stdp`	not allowed with `margins`

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

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

Remarks and examples

stata.com

Various predictions, statistics, and diagnostic measures are available after fitting a mixed-effects interval regression model with meintreg.

The predict command allows us to compute marginal and conditional predictions. Unless stated differently, we use the word "conditional" to mean "conditional on the empirical Bayes predictions of the random effects". The default prediction is the linear prediction, eta, which is the expected value of the unobserved censored variable. Predictions of expected values for censored and truncated versions of the response are also available.

▷ Example 1: Obtaining conditional and marginal probabilities

In example 1 of [ME] **meintreg**, we fit a three-level mixed-effects interval regression to model log time to udder tissue infection in dairy cows.

```
. use https://www.stata-press.com/data/r18/mastitis
(Simulated data on udder infection of dairy cows)
. generate lnleft = ln(left)
(5 missing values generated)
. generate lnright = ln(right)
(82 missing values generated)
. meintreg lnleft lnright i.multiparous || farm: || cow:
  (output omitted )
```

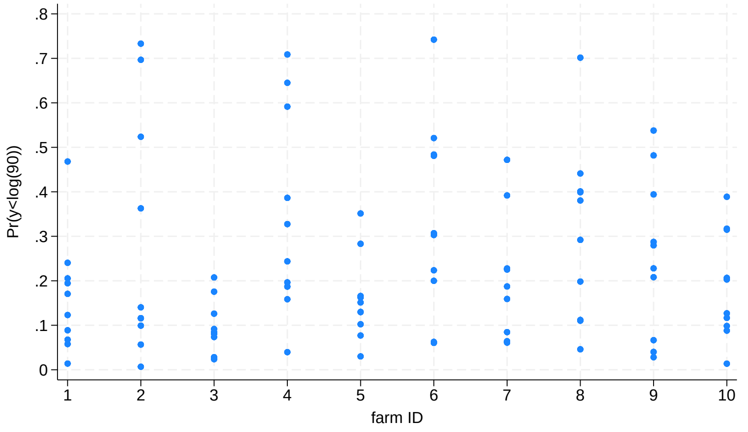
Let's assume that we want to predict the probability of infection within the first 90 days. Because our dependent variable is $\log(y)$, we need to compute

$$\Pr(0 < y < 90) = \Pr\{-\infty < \log(y) < \log(90)\}$$

We can use the pr() option for predict to compute the probability that our dependent variable lies in the interval $[-\infty, \log(90)]$.

We first compute the probability conditional on the random effects. Because the lower level on which we are conditioning on is cow, and we have only cow-level covariates, these predictions will be constant within cow. We can see that all the predicted probabilities for farm 3 are below 0.21, while the probabilities for farms 2 and 6 reach above 0.70 in some cases.

```
. predict pr_cond, pr(.,log(90))
(predictions based on fixed effects and posterior means of random effects)
. twoway scatter pr_cond farm, ylabel(0(.1).8) xlabel(1(1)10)
```



Now, we compute the marginal probabilities of infection within the first 90 days.

```
. predict pr_marg, pr(.,log(90)) marginal
. tabulate pr_marg multiparous

             |      =1 if cows
             | experienced more than
    Marginal |    one calving, 0
  Pr(y<log(9 |      otherwise
         0)) |         0          1 |     Total
-------------+----------------------+----------
    .0589298 |        40          0 |        40 
    .2158333 |         0        360 |       360 
-------------+----------------------+----------
       Total |        40        360 |       400 
```

Marginal predictions depend only on the covariate pattern (including covariates in the random-effects part, if present in the model). Because we included only a binary covariate in the model, there are only two predicted values, one for each value of the covariate. We see that the probability of developing an infection in the first 90 days is higher for multiparous cows.

Alternatively, we can use `margins` to calculate the marginal probabilities. One advantage of using `margins` is that we can obtain confidence intervals for the probabilities and the difference between them.

```
. margins multiparous, predict(pr(.,log(90)))
Adjusted predictions                                    Number of obs = 400
Model VCE: OIM

Expression: Pr(y<log(90)), predict(pr(.,log(90)))

------------------------------------------------------------------------------
             |            Delta-method
             |     Margin   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
 multiparous |
          0  |   .0589298   .0305541     1.93   0.054    -.0009551    .1188147
          1  |   .2158333   .0314158     6.87   0.000     .1542595    .2774071
------------------------------------------------------------------------------

. margins, dydx(multiparous) predict(pr(.,log(90)))
Conditional marginal effects                            Number of obs = 400
Model VCE: OIM

Expression: Pr(y<log(90)), predict(pr(.,log(90)))
dy/dx wrt:  1.multiparous

------------------------------------------------------------------------------
             |            Delta-method
             |      dy/dx   std. err.      z    P>|z|     [95% conf. interval]
-------------+----------------------------------------------------------------
1.multipar~s |   .1569036   .0396889     3.95   0.000     .0791148    .2346923
------------------------------------------------------------------------------
Note: dy/dx for factor levels is the discrete change from the base level.
```

The default option for **predict**, **eta**, computes the fitted linear prediction; we can use this option to perform predictions for the uncensored unobserved response. We compute the conditional and marginal predictions for the log time to infection.

```
. predict eta_cond
(option eta assumed)
(predictions based on fixed effects and posterior means of random effects)
(using 7 quadrature points)

. predict eta_marg, marginal
(option eta assumed)

. sort cow

. list cow multiparous eta_cond eta_marg in 1/8, sepby(cow)

     +-----------------------------------------+
     | cow   multip~s   eta_cond    eta_marg   |
     |-----------------------------------------|
  1. |   1          0   5.486386    5.644119   |
  2. |   1          0   5.486386    5.644119   |
  3. |   1          0   5.486386    5.644119   |
  4. |   1          0   5.486386    5.644119   |
     |-----------------------------------------|
  5. |   2          1   5.101668    5.075207   |
  6. |   2          1   5.101668    5.075207   |
  7. |   2          1   5.101668    5.075207   |
  8. |   2          1   5.101668    5.075207   |
     +-----------------------------------------+
```

Comparing the conditional and marginal predictions, we see that the predicted log time to infection for the first cow is slightly shorter than the one expected for a cow with this covariate pattern, and the log time to infection for the second cow is slightly longer.

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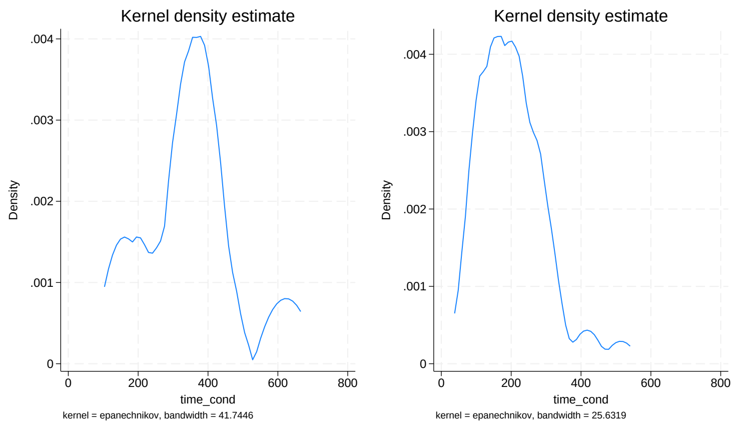
Example 2: Calculating transformed predictions

Because our dependent variable is log transformed, we might want to compute predictions on the original scale. To do that, we need to obtain predictions for the exponentiated dependent variable.

This exercise is helpful to understand the distribution of the different statistics. If we want to predict the individual conditional time to infection, we need to obtain the conditional mean for $\exp(y)$. Because the conditional distribution of $\exp(y)$ is lognormal with location parameter equal to $\widehat{\eta}$ and scale parameter equal to σ_ϵ (residual variance), then its (conditional) expected value is equal to $\exp(\widehat{\eta} + \sigma_\epsilon^2/2)$. Here we calculate the conditional time to infection and plot kernel densities for multiparous and uniparous cows.

```
. generate time_cond = exp(eta_cond + _b[/var(e.lnleft)]/2)
. kdensity time_cond if multiparous == 0, xlabel(0(200)800) name(gr1)
. kdensity time_cond if multiparous == 1, xlabel(0(200)800) name(gr2)
. graph combine gr1 gr2
```



The density estimator of the time to infection shows that multiparous cows tend to have shorter times to infection than uniparous cows.

The marginal distribution of y is lognormal with location parameter $\mathbf{x}\boldsymbol{\beta}$ and the scale parameter equal to the marginal variance; see *Methods and formulas* of [ME] **metobit postestimation** for the description of the marginal variance. Thus the marginal expected value of the time to infection is calculated as

```
. predict xb, xb
. generate time_marg = exp( xb + (_b[/var(_cons[farm])] +
> _b[/var(_cons[farm>cow])] + _b[/var(e.lnleft)])/2)
. tabulate time_marg multiparous
```

```
           |       =1 if cows
           | experienced more than
           |    one calving, 0
           |      otherwise
 time_marg |         0          1 |     Total
-----------+----------------------+----------
  209.1242 |         0        360 |       360
  369.3851 |        40          0 |        40
-----------+----------------------+----------
     Total |        40        360 |       400
```

As before, we see that the unconditional expected value for the time to infection is shorter for multiparous cows.

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Methods and formulas

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

Also see

[ME] **meintreg** — Multilevel mixed-effects interval regression

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