**nl postestimation** — Postestimation tools for nl

Postestimation commands predict margins Remarks and examples Also see

## Postestimation commands

The following postestimation commands are available after `nl`:

| Command | Description |
|---|---|
| `estat ic` | Akaike's, consistent Akaike's, corrected Akaike's, and Schwarz's Bayesian information criteria (AIC, CAIC, AICc, and BIC, respectively) |
| `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 |
| * `forecast` | dynamic forecasts and simulations |
| * `hausman` | Hausman's specification test |
| `lincom` | point estimates, standard errors, testing, and inference for linear combinations of parameters |
| * `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 parameters |
| `predict` | fitted values, residuals, etc. |
| `predictnl` | point estimates, standard errors, testing, and inference for generalized predictions |
| `test` | Wald tests of simple and composite linear hypotheses |
| `testnl` | Wald tests of nonlinear hypotheses |

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

†You must specify the `variables()` option with `nl`.

# predict

## Description for predict

`predict` creates a new variable containing predictions such as fitted values, residuals, probabilities, and expected values. It can also create multiple new variables containing predicted, named substitutable expressions.

## Menu for predict

Statistics > Postestimation

## Syntax for predict

*Syntax for predicting without named substitutable expressions (parameters)*

`predict` [*type*] *newvar* [*if*] [*in*] [ , *statistic*]

`predict` [*type*] *stub*`*` [*if*] [*in*], `scores`

*Syntax for predicting with named substitutable expressions (parameters)*

*Predict all parameters*

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

*Predict specific parameters*

`predict` [*type*] (*newvar* = {*param*:}) [(*newvar* = {*param*:}) [...]] [*if*] [*in*]

`predict` [*type*] {*stub*`*`|*newvarlist*} [*if*] [*in*], `parameters(`*paramnames*`)`

| *statistic* | Description |
|---|---|
| Main | |
| `yhat` | fitted values; the default |
| `residuals` | residuals |
| `pr(`*a*`,`*b*`)` | $\Pr(y_j \mid a < y_j < b)$ |
| `e(`*a*`,`*b*`)` | $E(y_j \mid a < y_j < b)$ |
| `ystar(`*a*`,`*b*`)` | $E(y_j^*)$, $y_j^* = \max\{a, \min(y_j, b)\}$ |

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

## Options for predict

Main

`yhat`, the default, calculates the fitted values.

`residuals` calculates the residuals.

`pr(`*a*`,`*b*`)` calculates $\Pr(a < f(\mathbf{x}_j,\mathbf{b}) + u_j < b)$, the probability that $y_j|\mathbf{x}_j$ 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 $\Pr(20 < f(\mathbf{x}_j,\mathbf{b}) + u_j < 30)$;
`pr(`*lb*`,`*ub*`)` calculates $\Pr(lb < f(\mathbf{x}_j,\mathbf{b}) + u_j < ub)$; and
`pr(20,`*ub*`)` calculates $\Pr(20 < f(\mathbf{x}_j,\mathbf{b}) + u_j < ub)$.

*a* missing ($a \geq .$) means $-\infty$; `pr(.,30)` calculates $\Pr(-\infty < f(\mathbf{x}_j,\mathbf{b}) + u_j < 30)$;
`pr(`*lb*`,30)` calculates $\Pr(-\infty < f(\mathbf{x}_j,\mathbf{b}) + u_j < 30)$ in observations for which $lb \geq .$
and calculates $\Pr(lb < f(\mathbf{x}_j,\mathbf{b}) + u_j < 30)$ elsewhere.

*b* missing ($b \geq .$) means $+\infty$; `pr(20,.)` calculates $\Pr(+\infty > f(\mathbf{x}_j,\mathbf{b}) + u_j > 20)$;
`pr(20,`*ub*`)` calculates $\Pr(+\infty > f(\mathbf{x}_j,\mathbf{b}) + u_j > 20)$ in observations for which $ub \geq .$
and calculates $\Pr(20 < f(\mathbf{x}_j,\mathbf{b}) + u_j < ub)$ elsewhere.

`e(`*a*`,`*b*`)` calculates $E(f(\mathbf{x}_j,\mathbf{b}) + u_j \mid a < f(\mathbf{x}_j,\mathbf{b}) + u_j < b)$, the expected value of $y_j|\mathbf{x}_j$ conditional on $y_j|\mathbf{x}_j$ being in the interval $(a,b)$, meaning that $y_j|\mathbf{x}_j$ is truncated. *a* and *b* are specified as they are for `pr()`.

`ystar(`*a*`,`*b*`)` calculates $E(y_j^*)$, where $y_j^* = a$ if $f(\mathbf{x}_j,\mathbf{b}) + u_j \leq a$, $y_j^* = b$ if $f(\mathbf{x}_j,\mathbf{b}) + u_j \geq b$, and $y_j^* = f(\mathbf{x}_j,\mathbf{b}) + u_j$ otherwise, meaning that $y_j^*$ is censored. *a* and *b* are specified as they are for `pr()`.

`scores` calculates the scores. The *j*th new variable created will contain the score for the *j*th parameter in `e(b)`.

`parameters` and `parameters(`*paramnames*`)` calculate predictions for all or a subset of the named substitutable expressions in the model. `parameters()` does not appear in the dialog box.

*paramnames* is *param* [ *param* [ . . . ] ], and *param* is a name of a substitutable expression as specified in one of `nl`'s `define()` options.

# margins

## Description for margins

`margins` estimates margins of response for fitted values.

## Menu for margins

Statistics > Postestimation

## Syntax for margins

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

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

| *statistic* | Description |
|---|---|
| `yhat` | fitted values; the default |
| `pr(`*a*`,`*b*`)` | not allowed with `margins` |
| `e(`*a*`,`*b*`)` | not allowed with `margins` |
| `ystar(`*a*`,`*b*`)` | not allowed with `margins` |
| `residuals` | not allowed with `margins` |
| `parameters` | predicted parameters |
| `parameters(`*param*`)` | predicted, named substitutable expression *param* |

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

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

# Remarks and examples

## Example 1: Basic usage of `predict` and `margins`

Obtaining predictions after fitting a nonlinear regression model with `nl` is no more difficult than obtaining predictions after fitting a linear regression model with `regress`. Here we fit a model of `mpg` on `weight`, allowing for a nonlinear relationship:

```
. use https://www.stata-press.com/data/r19/auto
(1978 automobile data)
. nl (mpg = {b0} + {b1}*weight^{gamma=-.5}), variables(weight) nolog
```

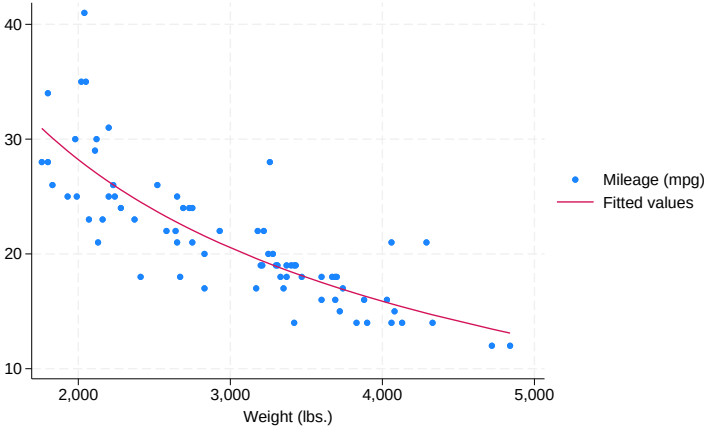
| Source | SS | df | MS | | |
|---|---|---|---|---|---|
| | | | | Number of obs = | 74 |
| Model | 1646.4376 | 2 | 823.218805 | R-squared = | 0.6738 |
| Residual | 797.02185 | 71 | 11.2256599 | Adj R-squared = | 0.6646 |
| | | | | Root MSE = | 3.350472 |
| Total | 2443.4595 | 73 | 33.4720474 | Res. dev. = | 385.8874 |

| mpg | Coefficient | Std. err. | t | P>\|t\| | [95% conf. | interval] |
|---|---|---|---|---|---|---|
| /b0 | -18.17687 | 60.62086 | -0.30 | 0.765 | -139.0514 | 102.6977 |
| /b1 | 1377.163 | 5291.956 | 0.26 | 0.795 | -9174.697 | 11929.02 |
| /gamma | -.4460793 | .6763682 | -0.66 | 0.512 | -1.794719 | .9025606 |

Note: Parameter **b0** is used as a constant term during estimation.

Now, we obtain the predicted values of `mpg` and plot them in a graph along with the observed values:

```
. predict mpghat
(option yhat assumed; fitted values)
. scatter mpg weight || line mpghat weight, sort
```



Suppose we wanted to know how sensitive mpg is to changes in weight for cars that weigh 3,000 pounds. We can use margins to find out:

```
. margins, eyex(weight) at(weight = 3000)
Conditional marginal effects                                    Number of obs = 74
Model VCE: GNR

Expression: Fitted values, predict()
ey/ex wrt:  weight
At: weight = 3000
```

| | ey/ex | Delta-method std. err. | z | P>\|z\| | [95% conf. | interval] |
|---|---|---|---|---|---|---|
| weight | -.8408143 | .0804327 | -10.45 | 0.000 | -.9984596 | -.683169 |

With the eyex() option, margins reports elasticities. These results show that if we increase weight by 1%, then mpg decreases by about 0.84%.

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## ❑ Technical note

Observant readers will notice that margins issued a warning message stating that it could not perform its usual check for estimable functions. In the case of nl, as long as you do not specify the predict() option of margins or specify the default predict(yhat), you can safely ignore that message. The predicted values that nl produces are suitable for use with margins. However, if you specify any predict() options other than yhat, then the output from margins after using nl will not be correct.

❑

## ▷ Example 2: Predictions from named expressions

Continuing with example 1, consider now a logistic regression that explains the origin of the cars as a function of their price, their fuel efficiency, and their length.

```
. logit foreign price mpg length
Iteration 0:  Log likelihood =  -45.03321
Iteration 1:  Log likelihood = -27.130212
Iteration 2:  Log likelihood = -23.885718
Iteration 3:  Log likelihood = -23.468167
Iteration 4:  Log likelihood = -23.460272
Iteration 5:  Log likelihood = -23.460253
Iteration 6:  Log likelihood = -23.460253
Logistic regression                                     Number of obs =     74
                                                        LR chi2(3)    =  43.15
                                                        Prob > chi2   = 0.0000
Log likelihood = -23.460253                             Pseudo R2     = 0.4790
```

| foreign | Coefficient | Std. err. | z | P>\|z\| | [95% conf. | interval] |
|---|---|---|---|---|---|---|
| price | .0005602 | .0001889 | 2.97 | 0.003 | .0001899 | .0009306 |
| mpg | -.0606663 | .0854276 | -0.71 | 0.478 | -.2281012 | .1067687 |
| length | -.1718435 | .0538215 | -3.19 | 0.001 | -.2773316 | -.0663553 |
| _cons | 27.7666 | 9.860407 | 2.82 | 0.005 | 8.440557 | 47.09264 |

After fitting this model, the predict command computes predicted probabilities by default or the linear prediction if we use the xb option:

```
. predict p_logit
(option pr assumed; Pr(foreign))
. predict xb_logit, xb
```

Next recall that logistic regression fits the logistic cumulative density function to our data via maximum likelihood. We could instead fit this (nonlinear) function via nonlinear least squares using the nl command:

```
. nl (foreign = 1/(1 + exp(-{lp: price mpg length})))
Iteration 0:  Residual SS =       18.5
Iteration 1:  Residual SS =  7.7385558
Iteration 2:  Residual SS =  7.6199595
Iteration 3:  Residual SS =  7.6149448
Iteration 4:  Residual SS =  7.6143961
Iteration 5:  Residual SS =  7.6143036
Iteration 6:  Residual SS =  7.6142876
Iteration 7:  Residual SS =  7.6142848
Iteration 8:  Residual SS =  7.6142843
```

| Source | SS | df | MS | | |
|---|---|---|---|---|---|
| | | | | Number of obs = | 74 |
| Model | 7.8451752 | 3 | 2.61505839 | R-squared = | 0.5075 |
| Residual | 7.6142843 | 70 | .10877549 | Adj R-squared = | 0.4864 |
| | | | | Root MSE = | .3298113 |
| Total | 15.459459 | 73 | .211773417 | Res. dev. = | 41.72401 |

| foreign | Coefficient | Std. err. | t | P>\|t\| | [95% conf. | interval] |
|---|---|---|---|---|---|---|
| price | .0006768 | .0002826 | 2.39 | 0.019 | .0001131 | .0012405 |
| mpg | -.0703169 | .0704894 | -1.00 | 0.322 | -.2109036 | .0702698 |
| length | -.2241772 | .0912304 | -2.46 | 0.016 | -.4061305 | -.042224 |
| _cons | 36.6067 | 15.28359 | 2.40 | 0.019 | 6.124531 | 67.08886 |

```
Note: Parameter _cons is used as a constant term during estimation.
```

Computing predicted probabilities from this model is still the default for predict because these are simply the values our model predicts for the dependent variable:

```
. predict p_nl
(option yhat assumed; fitted values)
```

To obtain the linear prediction, we need the predicted values of the named linear combination {lp:} we created. We can compute those using the parameters() option:

```
. predict xb_nl, parameters(lp)
```

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## Also see

[R] **nl** — Nonlinear least-squares estimation

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



For suggested citations, see the FAQ on citing Stata documentation.