# Title

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**irt 3pl postestimation —** Postestimation tools for irt 3pl

Postestimation commands predict Methods and formulas Also see

## Postestimation commands

The following postestimation commands are of special interest after `irt 3pl`:

| Command | Description |
|---|---|
| `estat report` | report estimated IRT parameters |
| `irtgraph icc` | plot item characteristic curve (ICC) |
| `irtgraph iif` | plot item information function (IIF) |
| `irtgraph tcc` | plot test characteristic curve (TCC) |
| `irtgraph tif` | plot test information function (TIF) |

The following standard postestimation commands are also available:

| Command | Description |
|---|---|
| `estat ic` | Akaike's and Schwarz's Bayesian information criteria (AIC 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 |
| `lincom` | point estimates, standard errors, testing, and inference for linear combinations of coefficients |
| * `lrtest` | likelihood-ratio test |
| `nlcom` | point estimates, standard errors, testing, and inference for nonlinear combinations of coefficients |
| `predict` | predictions |
| `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 |

* `lrtest` is not appropriate with `svy` estimation results.

# predict

## Description for predict

`predict` creates a new variable containing predictions such as probabilities, linear predictions, and parameter-level scores.

## Menu for predict

Statistics > Postestimation

## Syntax for predict

*Syntax for obtaining predictions of item probabilities and other statistics*

`predict` [*type*] *newvarsspec* [*if*] [*in*] [`,` *statistic* *item_options*]

*Syntax for obtaining estimated latent variables and their standard errors*

`predict` [*type*] *newvarsspec* [*if*] [*in*]`, latent` [*latent_options*]

*Syntax for obtaining parameter-level scores*

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

*newvarsspec* is *stub*`*` or *newvarlist*.

| *statistic* | Description |
|---|---|
| Main | |
| `pr` | probabilities; the default |
| `xb` | linear prediction |

| *item_options* | Description |
|---|---|
| Main | |
| `conditional(`*ctype*`)` | compute *statistic* conditional on estimated latent variables; default is `conditional(ebmeans)` |
| `marginal` | compute *statistic* marginally with respect to the latent variables |
| `outcome(`*item*`)` | specify item variable; default is all variables |
| Integration | |
| *int_options* | integration options |

| *ctype* | Description |
|---|---|
| `ebmeans` | empirical Bayes means of latent variables; the default |
| `ebmodes` | empirical Bayes modes of latent variables |
| `fixedonly` | prediction for the fixed portion of the model only |

| *latent_options* | Description |
|---|---|
| Main | |
| ebmeans | use empirical Bayes means of latent trait; the default |
| ebmodes | use empirical Bayes modes of latent trait |
| se(*newvar*) | calculate standard errors |
| 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

pr, the default, calculates the predicted probability.

xb specifies that the linear predictor be calculated.

outcome(*item*) specifies that predictions for *item* be calculated. Predictions for all observed response variables are computed by default.

conditional(*ctype*) and marginal specify how latent variables are handled in computing *statistic*.

conditional() specifies that *statistic* will be computed conditional on specified or estimated latent variables.

conditional(ebmeans), the default, specifies that empirical Bayes means be used as the estimates of the latent variables. These estimates are also known as posterior mean estimates of the latent variables.

conditional(ebmodes) specifies that empirical Bayes modes be used as the estimates of the latent variables. These estimates are also known as posterior mode estimates of the latent variables.

conditional(fixedonly) specifies that all latent variables be set to zero, equivalent to using only the fixed portion of the model.

marginal specifies that the predicted *statistic* be computed marginally with respect to the latent variables, which means that *statistic* is calculated by integrating the prediction function with respect to all the latent variables over their entire support.

Although this is not the default, marginal predictions are often very useful in applied analysis. They produce what are commonly called population-averaged estimates.

latent specifies that the latent trait is predicted using an empirical Bayes estimator; see options ebmeans and ebmodes.

ebmeans specifies that empirical Bayes means are used to predict the latent variables.

`ebmodes` specifies that empirical Bayes modes are used to predict the latent variables.

`se(`*newvar*`)` calculates standard errors of the empirical Bayes estimator and stores the result in *newvar*. This option requires the `latent` option.

`scores` calculates the scores for each coefficient in `e(b)`. This option requires a new variable list of the length equal to the number of columns in `e(b)`. Otherwise, use *stub*`*` to have `predict` generate enumerated variables with prefix *stub*.

Integration

`intpoints(#)` specifies the number of quadrature points used to compute marginal predictions and the empirical Bayes means; the default is the value from estimation.

`iterate(#)` specifies the maximum number of iterations when computing statistics involving empirical Bayes estimators; the default is the value from estimation.

`tolerance(#)` specifies convergence tolerance when computing statistics involving empirical Bayes estimators; the default is the value from estimation.

## Methods and formulas

Empirical Bayes predictions of the latent trait are documented in *Methods and formulas* of [IRT] **irt hybrid postestimation**.

This section builds on the notation introduced in *Methods and formulas* of [IRT] **irt 3pl**.

When the `marginal` option is specified, the predicted probability is computed as

$$\widehat{p}_{ij} = \widehat{c}_i + (1-\widehat{c}_i)\int_{-\infty}^{\infty} \frac{\exp(\widehat{\alpha}_i\,\theta_j + \widehat{\beta}_i)}{1+\exp(\widehat{\alpha}_i\,\theta_j + \widehat{\beta}_i)}\phi(\theta_j)\,d\theta_j$$

where $\widehat{\alpha}_i$, $\widehat{\beta}_i$, and $\widehat{\gamma}_i$ are the estimated parameters in the slope-intercept parameterization, and

$$\widehat{c}_i = \frac{\exp(\widehat{\gamma}_i)}{1+\exp(\widehat{\gamma}_i)}$$

The integral is approximated using standard Gauss–Hermite quadrature.

In what follows, we show formulas using the posterior means estimates of latent trait $\widetilde{\theta}_j$, which are computed by default or when the `conditional(ebmeans)` option is specified. If the `conditional(ebmodes)` option is specified, $\widetilde{\theta}_j$ are simply replaced with the posterior modes $\widetilde{\widetilde{\theta}}_j$ in these formulas.

For the response to item $i$ from person $j$, the linear predictor is computed as

$$\widehat{z}_{ij} = \widehat{\alpha}_i\,\widetilde{\theta}_j + \widehat{\beta}_i$$

If option `marginal` or `conditional(fixedonly)` is specified, the linear predictor is computed as

$$\widehat{z}_{ij} = \widehat{\beta}_i$$

The predicted probability, conditional on the predicted latent trait, is

$$\widehat{p}_{ij} = \widehat{c}_i + (1-\widehat{c}_i)\frac{\exp(\widehat{z}_{ij})}{1+\exp(\widehat{z}_{ij})}$$

## Also see

[IRT] **irt 3pl** — Three-parameter logistic model

[IRT] **estat report** — Report estimated IRT parameters

[IRT] **irtgraph icc** — Item characteristic curve plot

[IRT] **irtgraph iif** — Item information function plot

[IRT] **irtgraph tcc** — Test characteristic curve plot

[IRT] **irtgraph tif** — Test information function plot

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