## irtgraph iif - Item information function plot

Description	Quick start	Menu	Syntax	Options
Remarks and examples	Methods and formulas	References	Also see	

# Description

irtgraph iif plots item information functions (IIFs) for items in the currently fitted IRT model.

# **Quick start**

2PL model for binary items b1 to b10 irt 2pl b1-b10 Plot IIFs for all items in the model

irtgraph iif

Plot IIFs for items b1 and b5 irtgraph iif b1 b5

Fit a group 2PL model

irt 2pl b1-b9, group(female)

Plot IIFs for items b1 and b5 for both groups irtgraph iif b1 b5

Plot IIFs for item b1 for both groups and for item b5 for group 1 irtgraph iif (b1) (1: b5)

# Menu

Statistics > IRT (item response theory)

## Syntax

Basic syntax

```
irtgraph iif [varlist] [, options]
```

Full syntax

```
irtgraph iif ([#:] varlist [, line_options]) ([#:] varlist [, line_options]) [...]
[, options]
```

varlist is a list of items from the currently fitted IRT model.

#: selects items in *varlist* for the specified group.

options	Description	
Plots <u>ra</u> nge(##)	plot over $\theta = \#$ to $\#$	
Line line_options	affect rendition of the plotted IIFs	
Add plots addplot( <i>plot</i> )	add other plots to the IIF plot	
Y axis, X axis, Titles, Legend, Overall twoway_options	any options other than by () documented in [G-3] <i>twoway_options</i>	
Data n(#) data( <i>filename</i> [, replace])	evaluate IIFs at # points; default is n(300) save plot data to a file	

line\_options in (varlist, line\_options) override the same options specified in options.

# Options

Plots

range (# #) specifies the range of values for  $\theta$ . This option requires a pair of numbers identifying the minimum and maximum. The default is range (-4 4).

∫ Line Ì

*line\_options* affect the rendition of the plotted IIFs; see [G-3] *line\_options*.

Add plots

addplot (plot) allows adding more graph twoway plots to the graph; see [G-3] addplot\_option.

Y axis, X axis, Titles, Legend, Overall

*twoway\_options* are any of the options documented in [G-3] *twoway\_options*, excluding by(). These include options for titling the graph (see [G-3] *title\_options*) and for saving the graph to disk (see [G-3] *saving\_option*).

Data

n(#) specifies the number of points at which the IIFs are to be evaluated. The default is n(300).

data(*filename*[, replace]) saves the plot data to a Stata data file.

#### **Remarks and examples**

irtgraph iif plots IIFs after estimating the parameters of an IRT model using irt.

In IRT, the term "information" is used to describe reliability or precision of an item or a whole instrument. More reliable items measure the latent trait around the estimated difficulty parameter with greater precision.

IIFs are useful in test development and item evaluation. Depending on the specific needs of the test, items can be chosen to cover the whole spectrum or to focus on a particular range of the ability scale.

The example below shows how to use irtgraph iif after a simple 2PL model; see example 4 of [IRT] irtgraph icc for remarks on how irtgraph iif behaves after a group IRT model.

#### Example 1: IIF for binary items

. irtgraph iif

We continue with the 2PL model from example 1 of [IRT] irt 2pl. Recall that we fit a 2PL model to the nine binary items.

```
. use https://www.stata-press.com/data/r19/masc1
(Data from De Boeck & Wilson (2004))
. irt 2pl q1-q9
(output omitted)
```

Now we plot the IIF for each item in the fitted model.

```
Item information functions
    .8
                                                                                                    a1
    .6
                                                                                                    q2
                                                                                                    q3
nformation
                                                                                                    q4
    .4
                                                                                                    q5
                                                                                                    q6
                                                                                                    q7
                                                                                                    q8
    .2
                                                                                                    q9
                            -2
                                                                     ż
                                                 0
                                              Theta
```

For binary items, the amount of information is proportional to the discrimination parameter. Items q1 and q8 have the two highest discrimination estimates and provide more information than the remaining items. For a 2PL model, the maximum information is provided at  $\theta = b_i$ .

irtgraph iif's full syntax allows us to apply line styles to each item as we see fit. Let's say we expect more discrimination and therefore more information from a relatively difficult item q5 and thus want q5 to stand out in the IIF plot. To accomplish this, we specify thick and black line styles for q5 to distinguish it from the other items, which we specify with red and dashed line styles.

```
. irtgraph iif (q1-q4 q6-q9, lcolor(red) lpattern(dash))
```

> (q5, lcolor(black) lwidth(thick)), legend(off)



Looking at either IIF graph, we seem to have more item information in the negative region of the latent trait than in the positive region. This suggests that the whole test provides more information about students located at the lower end of the latent trait spectrum, which we show graphically in example 1 of [IRT] irtgraph tif.

4

#### Methods and formulas

For a given item *i* with categories k = 1, ..., K, let  $p_{ik}(\theta)$  be the probability of a respondent with latent trait value  $\theta$  selecting response category *k*. The functional form of  $p_{ik}(\theta)$  depends on the IRT model used to fit item *i* to the data. The category information function, for category *k* of item *i*, is defined as

$$I_{ik}(\theta) = -\frac{\partial^2 \log p_{ik}(\theta)}{\partial \theta^2}$$

The IIF for item *i* is the sum of its category information functions, weighted by the category probabilities.

$$I_i(\theta) = \sum_{k=1}^K I_{ik}(\theta) p_{ik}(\theta)$$

See Birnbaum (1968) and Samejima (1969, 1972, 1977) for a more detailed discussion of item information functions.

### References

- Birnbaum, A. 1968. "Some latent trait models and their use in inferring an examinee's ability". In Statistical Theories of Mental Test Scores, edited by F. M. Lord and M. R. Novick, 395–479. Reading, MA: Addison–Wesley.
- Raciborski, R. 2015. Spotlight on irt. The Stata Blog: Not Elsewhere Classified. https://blog.stata.com/2015/07/31/ spotlight-on-irt/.
- Samejima, F. 1969. Estimation of latent ability using a response pattern of graded scores. *Psychometrika Monograph Supplement*, no. 17.

  - —. 1977. Weekly parallel tests in latent trait theory with some criticisms of classical test theory. Psychometrika 42: 193–198. https://doi.org/10.1007/BF02294048.

### Also see

- [IRT] irt Introduction to IRT models
- [IRT] irt 1pl One-parameter logistic model
- [IRT] irt 2pl Two-parameter logistic model
- [IRT] irt 3pl Three-parameter logistic model
- [IRT] irt grm Graded response model
- [IRT] irt hybrid Hybrid IRT models
- [IRT] irt nrm Nominal response model
- [IRT] irt pcm Partial credit model
- [IRT] irt rsm Rating scale model
- [IRT] irtgraph tif Test information function plot

Stata, Stata Press, Mata, NetCourse, and NetCourseNow are registered trademarks of StataCorp LLC. Stata and Stata Press are registered trademarks with the World Intellectual Property Organization of the United Nations. StataNow is a trademark of StataCorp LLC. Other brand and product names are registered trademarks or trademarks of their respective companies. Copyright © 1985–2025 StataCorp LLC, College Station, TX, USA. All rights reserved.



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