Title

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irtgraph iif — Item information function plot

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
```

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.

options	Description
Plots	
`range(# #)`	plot over $\theta = \#$ to $\#$
Line	
line_options	affect rendition of the plotted IIFs
Add plots	
`addplot(`*plot*`)`	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] ***twoway_options***
Data	
`n(#)`	evaluate IIFs at # points; default is `n(300)`
`data(`*filename*`[, replace])`	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 θ. This option requires a pair of numbers identifying the minimum and maximum. The default is `range(-4 4)`.

Line

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

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`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.

▷ Example 1: IIF for binary items

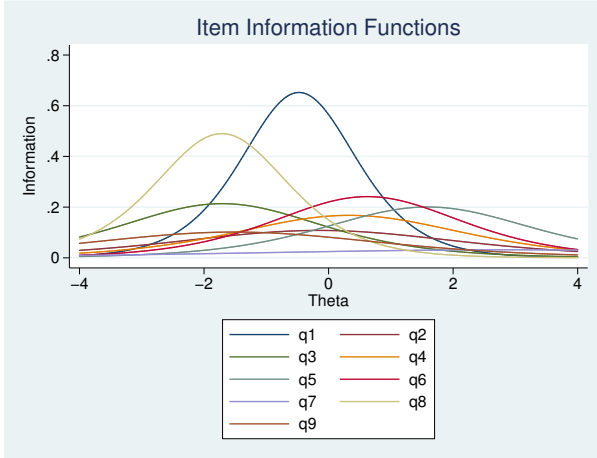
We continue with the 2PL model from example 1 of [IRT] **irt 2pl**. Recall that we fit a 2PL model to the nine binary items.

```
. use http://www.stata-press.com/data/r14/masc1
(Data from De Boeck & Wilson (2004))
. irt 2pl q1-q9
Fitting fixed-effects model:
Iteration 0:   log likelihood = -4275.6606
Iteration 1:   log likelihood = -4269.7861
Iteration 2:   log likelihood = -4269.7825
Iteration 3:   log likelihood = -4269.7825
Fitting full model:
Iteration 0:   log likelihood = -4146.9386
Iteration 1:   log likelihood = -4119.3568
Iteration 2:   log likelihood = -4118.4716
Iteration 3:   log likelihood = -4118.4697
Iteration 4:   log likelihood = -4118.4697
Two-parameter logistic model                    Number of obs     =        800
Log likelihood = -4118.4697
```

		Coef.	Std. Err.	z	P>|z|	[95% Conf.	Interval]
q1							
	Discrim	1.615292	.2436467	6.63	0.000	1.137754	2.092831
	Diff	-.4745635	.074638	-6.36	0.000	-.6208513	-.3282757
q2							
	Discrim	.6576171	.1161756	5.66	0.000	.4299171	.885317
	Diff	-.1513023	.1202807	-1.26	0.208	-.3870481	.0844435
q3							
	Discrim	.9245051	.1569806	5.89	0.000	.6168289	1.232181
	Diff	-1.70918	.242266	-7.05	0.000	-2.184012	-1.234347
q4							
	Discrim	.8186403	.1284832	6.37	0.000	.5668179	1.070463
	Diff	.3296791	.1076105	3.06	0.002	.1187663	.5405919
q5							
	Discrim	.8956621	.1535128	5.83	0.000	.5947825	1.196542
	Diff	1.591164	.2325918	6.84	0.000	1.135293	2.047036
q6							
	Discrim	.9828441	.147888	6.65	0.000	.6929889	1.272699
	Diff	.622954	.1114902	5.59	0.000	.4044373	.8414708
q7							
	Discrim	.3556064	.1113146	3.19	0.001	.1374337	.5737791
	Diff	2.840278	.8717471	3.26	0.001	1.131685	4.548871
q8							
	Discrim	1.399926	.233963	5.98	0.000	.9413668	1.858485
	Diff	-1.714416	.1925531	-8.90	0.000	-2.091814	-1.337019
q9							
	Discrim	.6378452	.1223972	5.21	0.000	.3979512	.8777392
	Diff	-1.508254	.2787386	-5.41	0.000	-2.054571	-.9619361

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

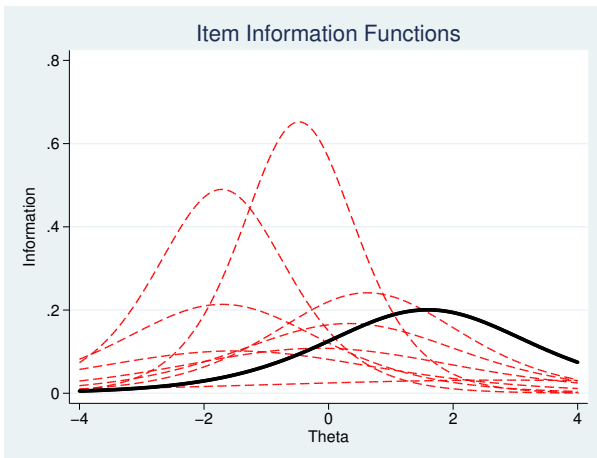
```
. irtgraph iif
```



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**.

◁

Methods and formulas

For a given item i with categories $k = 1, \ldots, K$, let $p_{ik}(\theta)$ be the probability of a respondent with latent trait value θ 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*, ed. F. M. Lord and M. R. Novick, 395–479. Reading, MA: Addison–Wesley.

Samejima, F. 1969. Estimation of latent ability using a response pattern of graded scores. *Psychometrika Monograph Supplement*, no. 17.

——. 1972. A general model for free-response data. *Psychometrika Monograph Supplement*, no. 18.

——. 1977. Weekly parallel tests in latent trait theory with some criticisms of classical test theory. *Psychometrika* 42: 193–198.

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