Title

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irtgraph tif — Test information function plot

Description

`irtgraph tif` plots the test information function (TIF) for the currently fitted IRT model.

Quick start

2PL model for binary items `b1` to `b10`

```
irt 2pl b1-b10
```

Plot the TIF for the fitted model

```
irtgraph tif
```

Plot the TIF and its standard error

```
irtgraph tif, se
```

Fit a group 2PL model

```
irt 2pl b1-b9, group(female)
```

Plot the TIFs for the fitted model for both groups

```
irtgraph tif
```

Menu

Statistics > IRT (item response theory)

Syntax

```
irtgraph tif [ , options ]
```

options	Description
Plots	
`se[(`*line_options*`)]`	plot the standard error of the TIF
`range(# #)`	plot over $\theta = \#$ to $\#$
Line	
line_options	affect rendition of the plotted TIF
Add plots	
`addplot(`*plot*`)`	add other plots to the TIF plot
Y axis, X axis, Titles, Legend, Overall	
twoway_options	any options other than `by()` documented in [G-3] ***twoway_options***
Data	
`n(#)`	evaluate TIF at # points; default is `n(300)`
`data(`*filename*`[ , replace ])`	save plot data to a file

Options

Plots

`se[(`*line_options*`)]` requests the standard error of the TIF be plotted. The optional *line_options* specify how the lines are rendered; see [G-3] ***line_options***.

`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 TIF; 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 plotted lines 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 tif` plots the TIF 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 instruments measure the latent trait around the estimated difficulty parameter with greater precision.

The TIF is useful in test development where, depending on the specific needs, the test can be chosen to cover the whole spectrum or to focus on a particular range of the ability scale. For tests with alternate formats, TIFs are used to ensure the formats carry the same information across the targeted latent trait range.

▷ Example 1: TIF for binary items

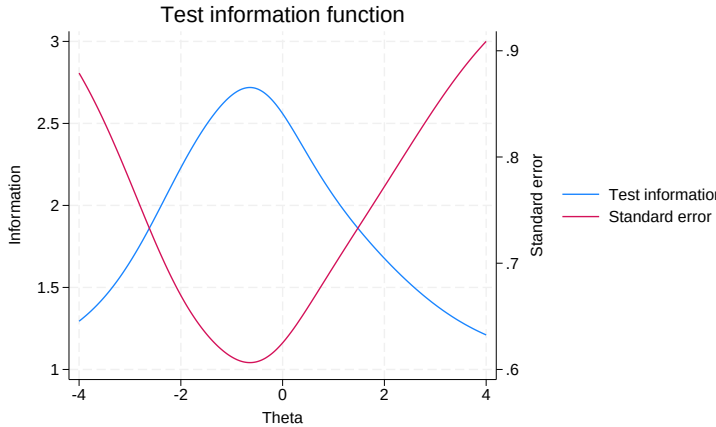
We continue with the 2PL model from example 1 of [IRT] **irt 2pl**. Recall that we fit a 2PL model to the nine binary items.

```
. use https://www.stata-press.com/data/r18/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
```

		Coefficient	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

In example 1 of [IRT] **irtgraph iif**, we plotted IIFs and noted that items provided more information over the negative range of the latent trait than over the positive range. This asymmetry is also present in the TIF, which we plot below.

```
. irtgraph tif, se
```



The test provides the most information around the latent trait between approximately -1.5 to 0. If we wished for the test to provide more information around a particular latent trait range, we could include additional items that contribute more information within the desired range. Looking at the standard error curve, we observe that the amount of information provided by the test at θ is inversely related to the precision with which ability is estimated at that point.

◁

Methods and formulas

Test information is the negative of the expectation of the second derivative with respect to θ of the log likelihood defined in *Methods and formulas* of [IRT] **irt hybrid**.

$$I(\theta) = -E\left\{\frac{\partial^2}{\partial\theta^2}\log L(\boldsymbol{B})\right\}$$

Given an instrument consisting of I items, the formula above reduces to

$$I(\theta) = \frac{1}{\sigma_\theta^2} + \sum_{i=1}^{I} I_i(\theta)$$

where $I_i(\theta)$ is as defined in *Methods and formulas* of [IRT] **irtgraph iif**. Thus, the TIF is the sum of the individual IIFs and the prior variance of the latent trait, σ_θ^2. `irt` fits IRT models with σ_θ^2 constrained to 1.

The standard error of the TIF is given by

$$\text{se}(\widehat{\theta}) = \frac{1}{\sqrt{I(\theta)}}$$

Reference

Raciborski, R. 2015. Spotlight on irt. *The Stata Blog: Not Elsewhere Classified.* http://blog.stata.com/2015/07/31/spotlight-on-irt/.

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 iif** — Item information function plot