

IRTTool.com

Building web applications with R

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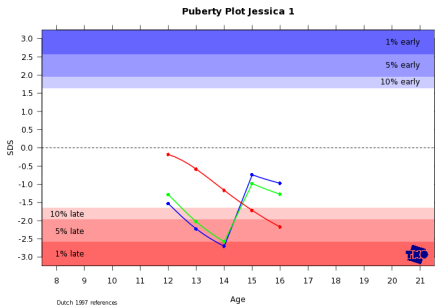
Utrecht University

July 9, 2009

useR 2009, Rennes

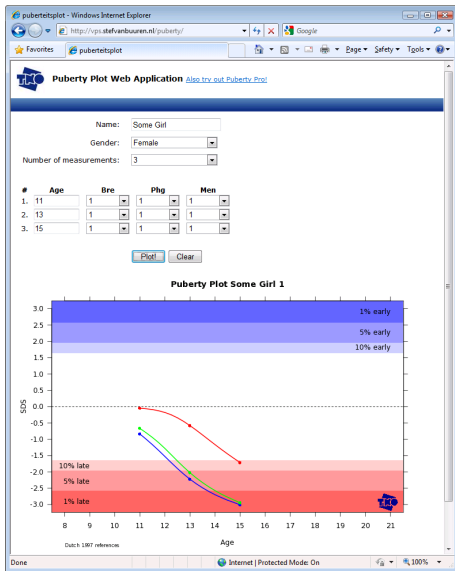
Example: Puberty Plot

- van Buuren S, Ooms JCL (2009). *Stage line diagram: An age-conditional reference diagram for tracking development*. *Statistics in Medicine*. pdf



- Introduces a new type of diagnostic diagram.
- How to make this directly and easily available for doctors and physicians to try out?

<http://vps.stefvanbuuren.nl/puberty>



Context

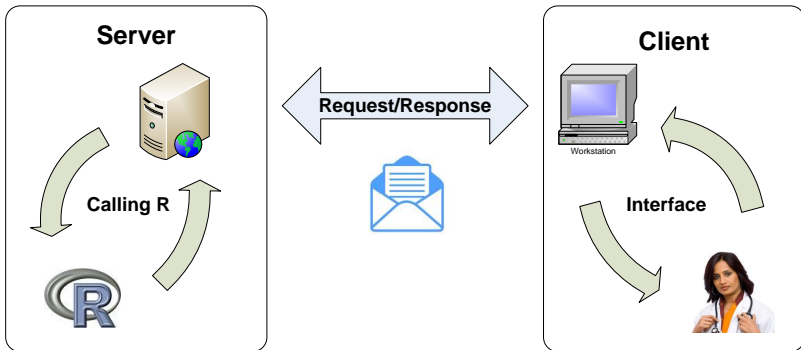
This presentation is about:

- Making Web Interfaces for Simple R applications.
- R runs on the server.
- User only needs a standard webbrowser.
- Programming in R and HTML/Javascript (No Java!).
- AJAX interfaces.

It is not about:

- Applications that require advanced queueing systems for running multiple simultaneous R jobs.
- Distributed Computing.
- Java.

Web application Setup



Puberty Plot example

1. Interface:
 - HTML form for age, gender, phb, gen, etc.
2. Request:
 - Ajax request to draw plot with form data.
3. Server:
 - Reads values and draws the plot to a web location.
4. Response:
 - Returns the location of the plotted figure.
5. Interface:
 - Updates figure within HTML page.

Server code: Calling R using RApache

```
source("/home/stef/external.r");

gender <- as.character(GET$gender[1]);
name <- as.character(GET$name[1]);
ages <- strsplit(as.character(GET$ages[1]),",")
phb <- strsplit(as.character(GET$phb[1]),",")

%----- >8 ----- Also parse other data...
randomnum <- round(runif(1,0,100000));

file <- paste("/var/www/puberty/plots/",name,randomnum,"pdf",sep=".")
pdf(file=file, paper="a4r",width=11.67, height=8.27)
plot.stadia(data=pub.data,title=paste("Puberty Plot",name))
dev.off()

file <- paste("/var/www/puberty/plots/",name,randomnum,"png",sep=".")
png(file=file, width=700, height=500)
plot.stadia(data=pub.data,title=paste("Puberty Plot",name))
dev.off()

cat(paste("",name,randomnum,sep=".") )
```

Client: AJAX update of PNG and PDFlink

```
new Ajax.Request('../brew/plotter.rhtml', {
  method: 'get',
  parameters: {
    gender: gender,
    name: name,
    number: number,
    age: ageString,
    gen: genString,
    phb: phbString,
    tv: tvString,
    reflines: reflines.toString()
  },
  onSuccess: function(transport){
    var response = transport.responseText;
    $("plotpng").setAttribute('src',"plots/"+ response + ".png");
    $("pdflink").setAttribute('href',"plots/"+ response + ".png");
  },
  onFailure: function() { alert('Ajax request failed...')
}
});
```


Message Specification: XML and JSON.

- For advanced web applications use a standard data format to communicate with the server.
- 2 obvious candidates: XML and JSON.
- You can use CRAN packages XML and rjson for parsing.
- XML is most widely used, probably preferable if you want to integrate your application in other software (consider SOAP).
- JSON is lighter and supports array's. Preferred for large datasets.

Example of XML Syntax

```
<myModel>
  <family>Gaussian</family>
  <deviance>3569.23</deviance>
  <coefficients>
    <coef>
      <name>Intercept</name>
      <value>5.69</value>
    </coef>
    <coef>
      <name>Age</name>
      <value>0.36</value>
    </coef>
    <coef>
      <name>Gender</name>
      <value>2.54</value>
    </coef>
  </coefficients>
</myModel>
```

Example of JSON Syntax

```
{ "myModel": {  
  "family": "Gaussian",  
  "deviance": 3569.23,  
  "coefficients":  
    [ {"Intercept": 5.69}, {"Age": 0.36}, {"Gender": 2.54} ]  
}
```

Or for example a dataframe:

```
{ "myData": {  
  "Age": [9, 8, 12, 6, 7, 8, 9, 8, 10, 11, 9, 6, 8],  
  "Gender": ["M", "F", "F", "M", "F", "M", "F", "F", "M", "F", "M", "F", "F"],  
  "Treatment": [1, 0, 0, 1, 1, 1, 0, 0, 0, 1, 1, 1, 0]  
}
```

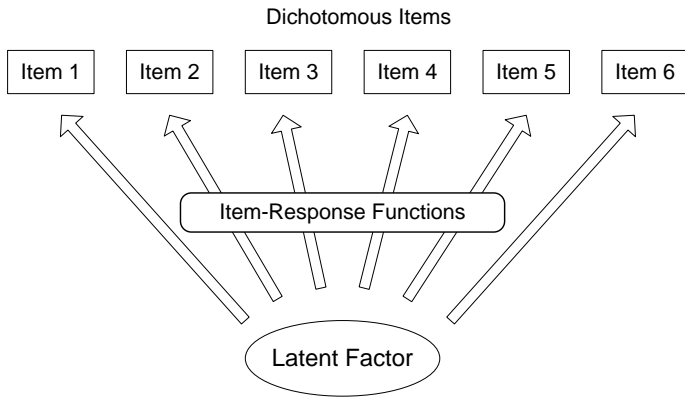
Graphical Interfaces

- There are many free and open-source javascript libraries that provide ready-to-use interfaces and widgets.
- Easily create Grids, Tabs, Windows, Drag/drop, Trees, Forms, Toolbars, etc with only a few lines of code.

Framework	License
Prototype/Scriptaculous	MIT
Yahoo! User Interface Library (YUI)	BSD
jQuery	GPL or MIT
Dojo	BSD
Ext	GPL or Commercial

The IRT model

- The IRT model links a set of dichotomous items to a latent factor (ability), using item response functions.

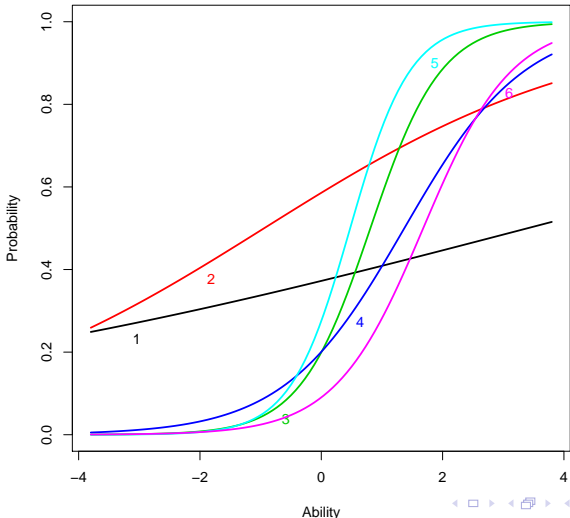


IRT Data

	item 1	item 2	item 3	item 4	item 5	item 6
Douglas	0	1	1	0	1	1
Vincent	1	0	1	1	1	1
Arthur	0	1	0	0	1	1
Pierre-Andre	0	1	1	0	1	1
Jan	1	0	1	0	1	0
Ramon	0	1	1	0	1	1
Marco	1	1	1	0	1	1
Nicolas	0	1	1	1	1	0
Torsten	1	1	1	1	1	0
François	0	0	1	1	1	0
Friedrich	1	0	1	1	1	1
Thomas	0	0	1	1	1	0
etc						

The IRT model

Item Characteristic Curves

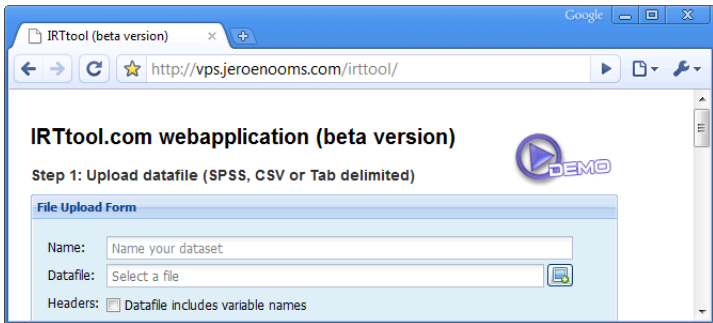


IRTtool.com

- IRTtool is a webapplication for online IRT analysis.
- It implements the CRAN package LTM by Dimitris Rizopoulos.
- For the interface, widgets from Ext are used.

Features

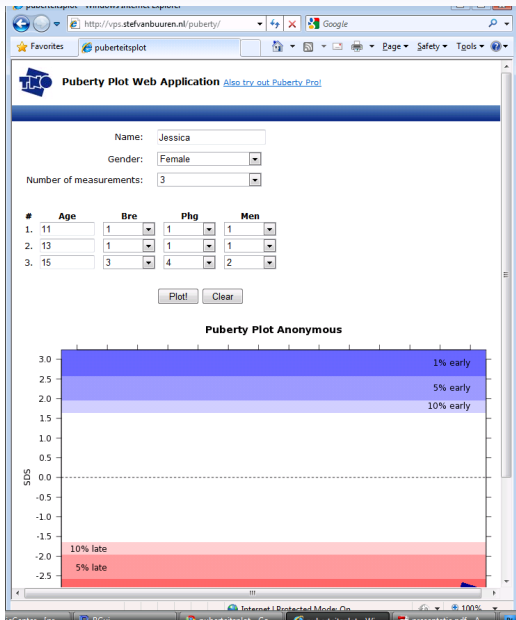
- Upload and import data files.
- Interactive model fitting.
- Windowed graphs.
- Export factors scores to CSV.
- Export to PDF.

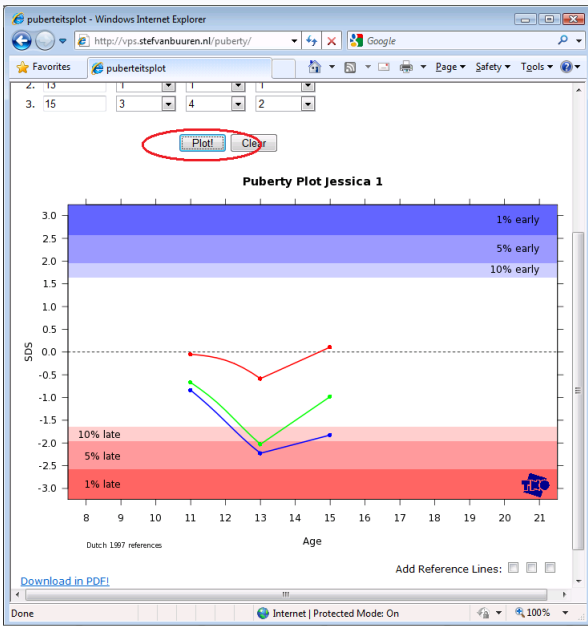


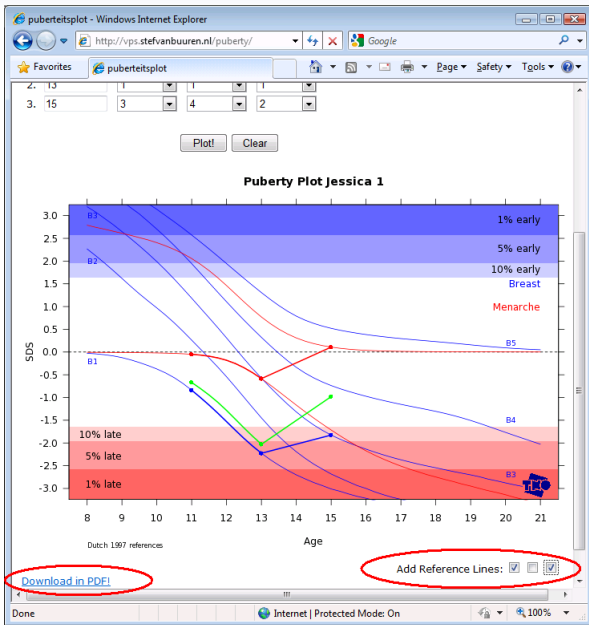
- Live demo: <http://www.irttool.com>
- Datafiles from ltm package:
 - WIRS.csv
 - Mobility.csv
 - Abortion.csv
 - LSAT.csv
- Demo Video

Thank you for your attention!

- Jeffrey Horner (2009). rapache: Web application development with R and Apache.
<http://biostat.mc.vanderbilt.edu/rapache/>
- Itm: An R package for Latent Variable Modelling and Item Response Theory Analyses.
<http://www.jstatsoft.org/v17/i05/>
- van Buuren S, Ooms JCL (2009). Stage line diagram: An age-conditional reference diagram for tracking development. *Statistics in Medicine*.
- w3schools: Full Web Building Tutorials - All Free.







IRTtool (beta version) - Mozilla Firefox

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http://vps.jeroenooms.com/irttool/

IRTtool.com webapplication (beta version)

Step 1: Upload datafile (SPSS, CSV or Tab delimited)

File Upload Form

Name:

Datafile: 

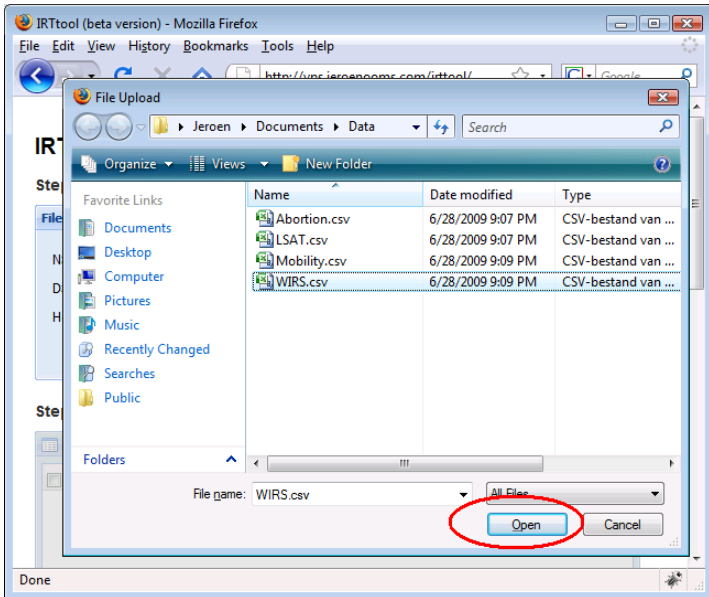
Headers: Datafile includes variable names

Step 2: Verify Data and Build a model

Select which variables you want to use.

<input type="checkbox"/>	Index	Variable name	Metric	Levels	Missing
<input type="checkbox"/>					

Done



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IRTtool.com webapplication (beta version)

Step 1: Upload datafile (SPSS, CSV or Tab delimited)

File Upload Form

Name:

Datafile:

Headers: Datafile includes variable names

Upload

Step 2: Verify Data and Build a model

Select which variables you want to use.

<input type="checkbox"/>	Index	Variable name	Metric	Levels	Missing
<input type="checkbox"/>					

Done

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IRTtool.com webapplication (beta version)

Step 1: Upload datafile (SPSS, CSV or Tab delimited)

DEMO

File Upload Form

Name: my dataset

Datafile: WIRS.csv

Headers: Datafile include headers

waiting...
contacting R server... please wait...

Step 2: Verify Data and Build a model

Select which variables you want to use.

<input type="checkbox"/>	Index	Variable name	Metric	Levels	Missing
<input type="checkbox"/>	1				
<input type="checkbox"/>	2				
<input type="checkbox"/>	3				

http://vps.jeroenooms.com/irttool/#

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http://vps.jeroenooms.com/irttool/

Name: my dataset

Datafile: WIRS.csv

Headers: Datafile includes variable names

Upload

Step 2: Verify Data and Build a model

Select which variables you want to use.

<input type="checkbox"/>	Index	Variable name	Metric	Levels	Missing
<input type="checkbox"/>	1	X	integer	1005	0
<input type="checkbox"/>	2	Item.1	integer	2	0
<input type="checkbox"/>	3	Item.2	integer	2	0
<input type="checkbox"/>	4	Item.3	integer	2	0
<input type="checkbox"/>	5	Item.4	integer	2	0
<input type="checkbox"/>	6	Item.5	integer	2	0
<input type="checkbox"/>	7	Item.6	integer	2	0

Done

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Headers: Datafile includes variable names

Upload

Step 2: Verify Data and Build a model

Select which variables you want to use.

<input type="checkbox"/>	Index	Variable name	Metric	Levels	Missing
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<input checked="" type="checkbox"/>	2	Item.1	integer	2	0
<input checked="" type="checkbox"/>	3	Item.2	integer	2	0
<input checked="" type="checkbox"/>	4	Item.3	integer	2	0
<input checked="" type="checkbox"/>	5	Item.4	integer	2	0
<input checked="" type="checkbox"/>	6	Item.5	integer	2	0
<input checked="" type="checkbox"/>	7	Item.6	integer	2	0

Select a model...

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Headers: Datafile includes variable names

Upload

Step 2: Verify Data and Build a model

Select which variables you want to use.

<input type="checkbox"/>	Index	Variable name	Metric	Levels	Missing
<input type="checkbox"/>	1	X	integer	1005	0
<input checked="" type="checkbox"/>	2	Item.1	integer	2	0
<input checked="" type="checkbox"/>	3	Item.2	integer	2	0
<input checked="" type="checkbox"/>	4	Item.3	integer	2	0
<input checked="" type="checkbox"/>	5	Item.4	integer	2	0
<input checked="" type="checkbox"/>	6	Item.5	integer	2	0
<input checked="" type="checkbox"/>	7	Item.6	integer	2	0

1p IRT Rasch

Fit Model!

Done

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http://vps.jeroenooms.com/irttool/

Headers: Datafile includes variable names

Upload

Step 2: Verify Data and Build a model

Select which variables you want to use.

<input type="checkbox"/>	Index	Variable name	Metric	Levels	Missing
<input type="checkbox"/>	1	X	integer	1005	0
<input checked="" type="checkbox"/>	2	Item.1	integer	2	0
<input checked="" type="checkbox"/>	3	Item.2	integer	2	0
<input checked="" type="checkbox"/>	4	Item.3	integer	2	0
<input checked="" type="checkbox"/>	5	Item.4	integer	2	0
<input checked="" type="checkbox"/>	6	Item.5	integer	2	0
<input checked="" type="checkbox"/>	7	Item.6	integer	2	0

waiting...
contacting R server... please wait...

1p IRT Rasch Fit Model!

http://vps.jeroenooms.com/irttool/#

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http://vps.jeroenooms.com/irttool/

1p IRT Rasch Fit Model!

Step 3: Check estimates and figures

Select a model.

Item	Variable name	Difficulty	Discrimination	Guess
1	Item.1	0.743	0.794	0.000
2	Item.2	-0.481	0.794	0.000
3	Item.3	1.329	0.794	0.000
4	Item.4	1.641	0.794	0.000
5	Item.5	0.841	0.794	0.000
6	Item.6	2.473	0.794	0.000

Done

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http://vps.jeroenooms.com/irttool/

2p IRT (ltm) Fit Model!

Step 3: Check estimates and figures

Select a model.

Item	Variable name	Difficulty	Discrimination	Guess
1	Item.1	3.401	0.153	0.000
2	Item.2	-0.942	0.368	0.000
3	Item.3	0.809	1.718	0.000
4	Item.4	1.369	1.010	0.000
5	Item.5	0.476	2.032	0.000
6	Item.6	1.680	1.375	0.000

http://vps.jeroenooms.com/irttool/#

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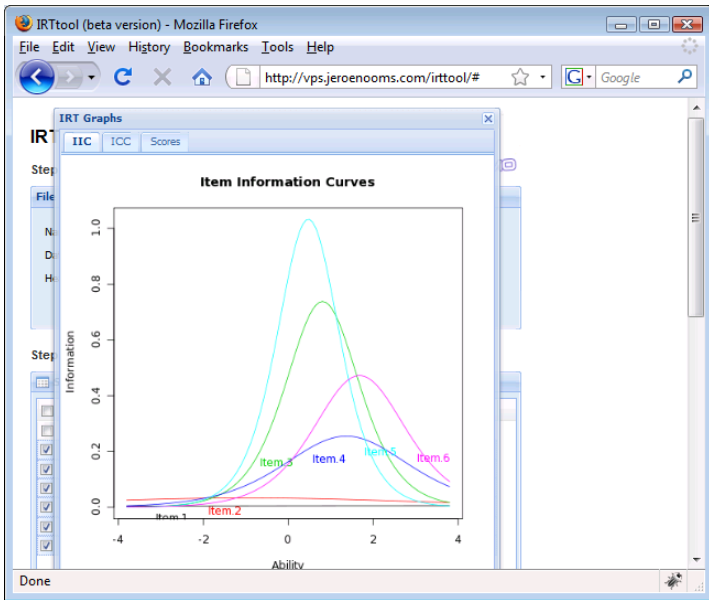
http://vps.jeroenooms.com/irttool/#

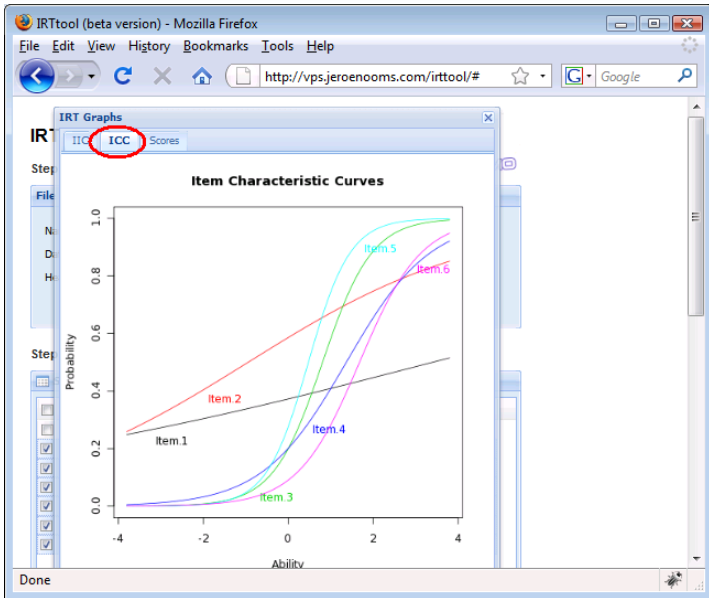
Step 3: Check estimates and figures

Select a model.

Item	Variable name	Difficulty	Discrimination	Guess
1	Item.1	3.401	0.153	0.000
2	Item.2	-0.942	0.368	0.000
3	Item.3	0.809	1.718	0.000
4	Item.4	1.369	1.010	0.000
5	Item.5	0.476	2.032	0.000
6	Item.6	1.680	1.375	0.000

Done





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http://vps.jeroenooms.com/irttool/#

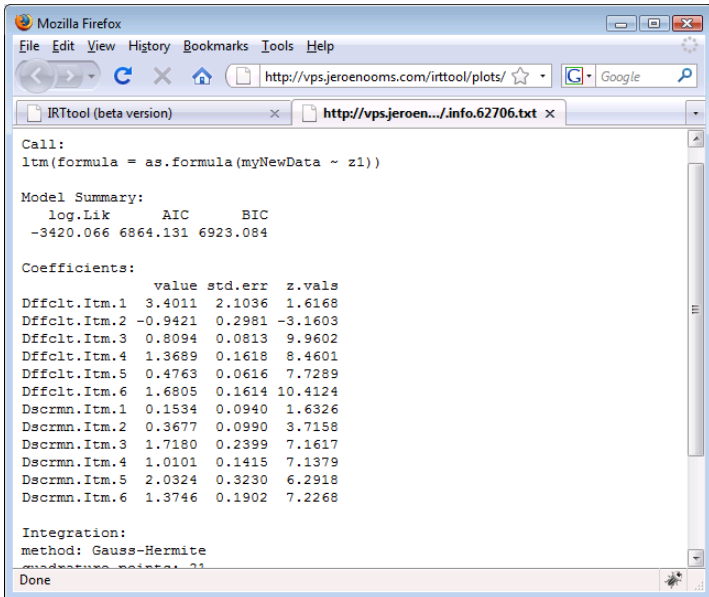
Step 3: Check estimates and figures

Select a model.

Item	Variable name	Difficulty	Discrimination	Guess
1	Item.1	3.401	0.153	0.000
2	Item.2	-0.942	0.368	0.000
3	Item.3	0.809	1.718	0.000
4	Item.4	1.369	1.010	0.000
5	Item.5	0.476	2.032	0.000
6	Item.6	1.680	1.375	0.000

Done





Mozilla Firefox

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http://vps.jeroenooms.com/irttool/plots/ Google

IRTtool (beta version) http://vps.jeroen.../info.62706.txt

Call:
ltm(formula = as.formula(myNewData ~ z1))

Model Summary:

log.Lik	AIC	BIC
-3420.066	6864.131	6923.084

Coefficients:

	value	std.err	z.vals
Dffclt.Itm.1	3.4011	2.1036	1.6168
Dffclt.Itm.2	-0.9421	0.2981	-3.1603
Dffclt.Itm.3	0.8094	0.0813	9.9602
Dffclt.Itm.4	1.3689	0.1618	8.4601
Dffclt.Itm.5	0.4763	0.0616	7.7289
Dffclt.Itm.6	1.6805	0.1614	10.4124
Dscrmn.Itm.1	0.1534	0.0940	1.6326
Dscrmn.Itm.2	0.3677	0.0990	3.7158
Dscrmn.Itm.3	1.7180	0.2399	7.1617
Dscrmn.Itm.4	1.0101	0.1415	7.1379
Dscrmn.Itm.5	2.0324	0.3230	6.2918
Dscrmn.Itm.6	1.3746	0.1902	7.2268

Integration:
method: Gauss-Hermite
method: Gauss-Hermite
Done

IRTtool (beta version) - Mozilla Firefox

File Edit View History Bookmarks Tools Help

http://vps.jeroenooms.com/irttool/#

IRTtool (beta version) x http://vps.jeroeno...ts/.data.62706.csv x

Select a model.

Item	Variable name	Difficulty	Discrimination	Guess
1	Item.1	3.401	0.153	0.000
2	Item.2	-0.942	0.368	0.000
3	Item.3	0.809	1.718	0.000
4	Item.4	1.369	1.010	0.000
5	Item.5	0.476	2.032	0.000
6	Item.6	1.680	1.375	0.000

Done

The screenshot shows a Microsoft Excel spreadsheet titled ".data.62706.csv - Microsoft Excel". The ribbon includes tabs for Start, Invoegen, Pagina-indeling, Formules, Gegevens, Controleren, Beeld, and Afdrukken. The data table is as follows:

	A	B	C	D	E	F	G	H	I	J	K	L
1		Item.1	Item.2	Item.3	Item.4	Item.5	Item.6	Obs	Exp	z1	se.z1	
2	1	0	0	0	0	0	0	132	136	-0.698	0.763	
3	134	0	0	0	0	0	0	1	5	7.013	-0.048	0.623
4	427	1	0	0	0	0	0	1	11	4.088	0.01	0.612
5	434	0	0	1	0	0	1	0	2	13.895	0.732	0.552
6	507	0	0	1	1	0	0	1	1	5.202	0.418	0.562
7	508	0	1	0	1	0	0	45	25.049	-0.047	0.623	
8	673	0	0	1	0	1	1	1	2	5.208	1.163	0.574
9	678	0	1	0	0	0	1	1	11	7.975	0.739	0.552
10	696	0	1	0	1	0	1	1	1	2.96	0.425	0.561
11	697	1	0	0	1	0	1	1	1	1.153	0.357	0.566
12	698	0	1	1	0	0	1	2	4.213	0.644	0.552	
13	700	1	0	1	0	0	1	8	1.557	0.578	0.553	
14	701	1	0	1	0	0	1	8	1.557	0.578	0.553	
15	709	1	1	0	0	0	1	10	5.761	0.143	0.591	
16	718	1	1	1	0	0	0	13	15.115	0.26	0.576	