Using RStudio and SnowIRT to get Rasch Results for a Test

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A working paper dated 12 February 2024. Click here for a possible update.

This work continues my look into alternatives to Lertap5 for instructors and students, carrying on from classical test analysis work presented in another working paper, a paper which also made use of SnowIRT. That paper is suggested reading as an introduction to jamovi and SnowIRT.

Below I discuss the use of the Rasch analysis capabilities of SnowIRT, and also use an RStudio script calling on TAM as alternatives to Lertap5's Rasch capability.

A recommended reference for the Rasch model may be found here. It introduces R and RStudio; see this site to download RStudio and R.

SnowIRT and RStudio are free resources.

For this paper I opted to work with a short multiple-choice test, "Test13", initially used *many* years ago in mathematics classes for primary-school students, well before electronic calculators had appeared[2]. I had previously used Lertap5 to investigate the quality of the test by using "CTT", classical test theory, and presented results here.

In preparation for the Rasch work below, I did two things: (1) from the original 2,727 student Test13 results, I used Lertap5 to weed out all students with extreme scores, that is, those with scores of zero, and also those with perfect scores of 13, leaving me with 2,645 students[3]. Then, (2), still working with Lertap5, I made use of its "omega1macro" to produce files for RStudio and SnowIRT. These included a file of item scores[4] for each student, called "OmegaIscores.csv", and an RStudio script called "RaschAnalysis-TAM.rmd".

Both R and RStudio had been installed on my computer. I was ready to look at Test13 item performance and I began with RStudio.

I opened RStudio and ran[5] the RaschAnalysis-TAM.rmd script[6]. It very quickly produced a Word document with results saved as "Rasch-Analysis-TAM.docx". That document may be viewed here.

That was certainly straightforward (to me). I had an item analysis report which included both classical and Rasch item response theory results and included several graphs.

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[1] mailto: l.nelson@curtin.edu.au
[2] The original test was in a language other than English. There may have been translation errors.
[3] Extreme scores are handled well in TAM, but I wasn't sure of SnowIRT.
[4] Item scores for test items are (0,1) scores – zero for an incorrect answer, one for correct.
[5] All I had to do was use RStudio's **"Knit"** option. Figs. 7 and 8 in this paper have an example of using Knit.
[6] Note the script's resp <- read.csv("Omega-IScores.csv") line and change as/if appropriate to another csv file.

Next, I went to the jamovi website and opted to download and install the desktop version for Windows. Figure 1 indicates what I saw after downloading, installing, and opening:
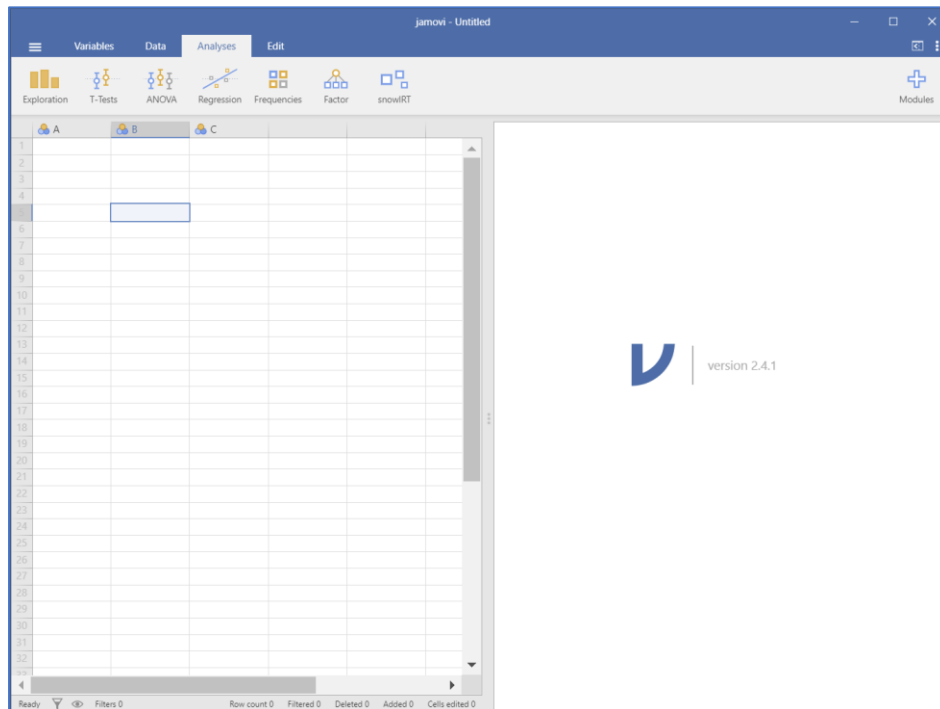

Figure 1

Readers may not see *exactly* what I present in Figure 1. That's because I had been using jamovi for some time and had already installed the SnowIRT module.

If you clean your glasses, or get out a magnifying glass, you may be able to spot it listed as one of the Analyses options over on the right side. Figure 2 might assist:
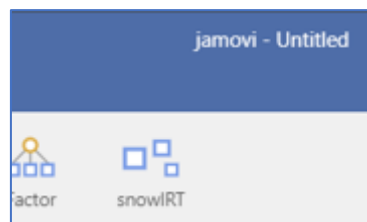
Figure 2

Jamovi does not come with SnowIRT already installed. Way over to the right of the snowIRT option in Figure 1 there's an option to access and install modules as seen below in Figure 3. I used it to find and install SnowIRT.
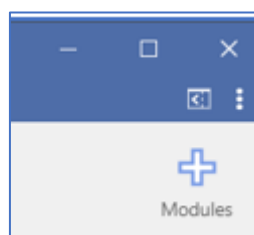

Figure 3

Okay. Now I want to open the file of item scores for each student. Above I said that Lertap5's omega1macro will create such a file and call it "OmegaIscores.csv".

I made a copy of that file and called it "Test13iscores2645.csv" – it may be download [from this link](#).
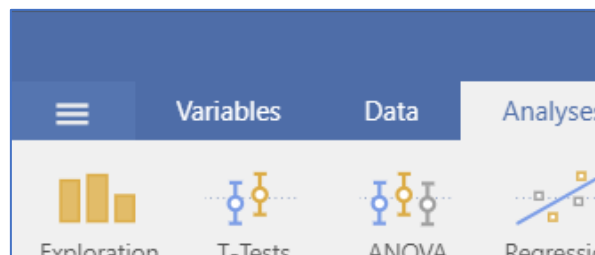
Ready!

Look now at the top left of jamovi's screen:

Figure 4

Those three white bars to the left of "Variables" in Figure 4 give access to an "open" option. Look now at Figure 5 if you would.
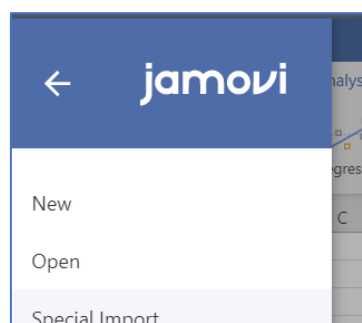

Figure 5

I take the "open" option and browse to where I had saved that file of item scores, that is, "Test13iscores2645.csv". The scores were loaded into jamovi and item scores for the first few students were displayed.

I then took the Exploration option at the top left of jamovi's screen and clicked on its "Descriptives" option. See Figure 6.

I clicked on the "Statistics" option and then selected the options seen in Figure 7[7].

Next, I selected all 13 items, Q1 to Q13 (only the first 8 show in Figure 6) and used the arrow to move them over to the right, under the "Variables" option.

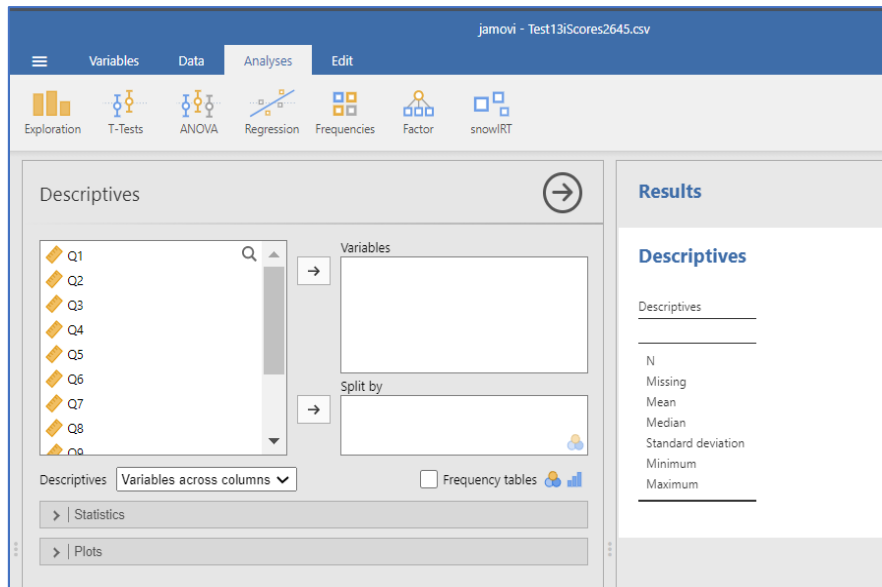[7] I also selected the "Mean" option under Central Tendency but that's not seen in Fig.7
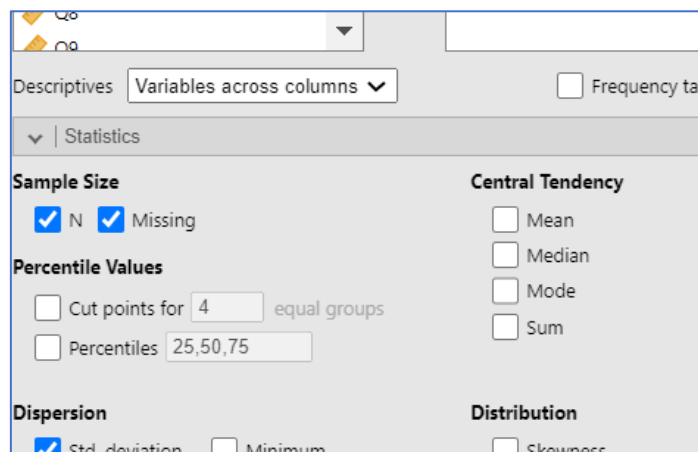
Figure 6

Figure 7

Figure 8

Figure 8 displays results for the initial six items, and I note that quite a number of students did not answer some of the items – for example, 266 did not answer Q2.

Okay, now to SnowIRT's Rasch options. I click on snowIRT up on the Analyses tab. See now Figure 9.
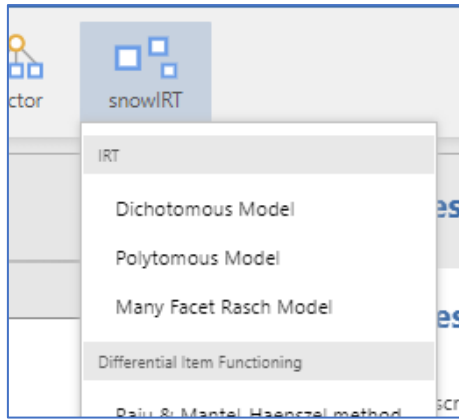
Figure 9

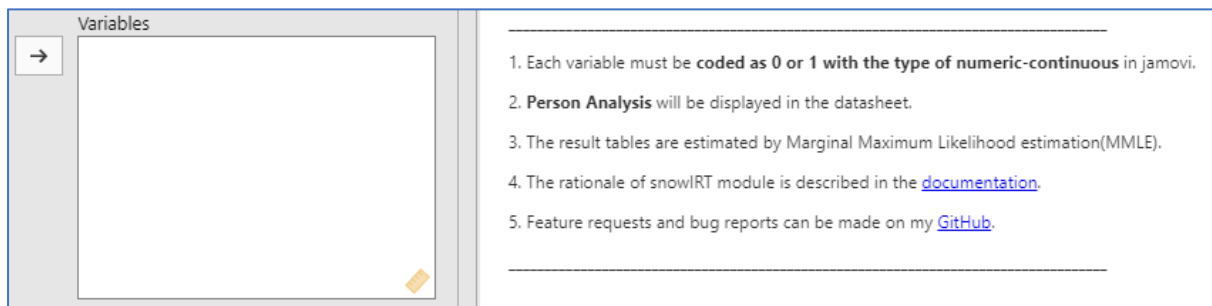I click on "Dichotomous Model" and take note of what's shown below in Figure 10.

Figure 10

I'm almost there. I now select all 13 items and use the arrow to again move them over to the "Variables" side – whoops, no, first I select the analysis options seen in Figure 11, and <u>then</u> I move Q1 to Q13 over to Variables side.
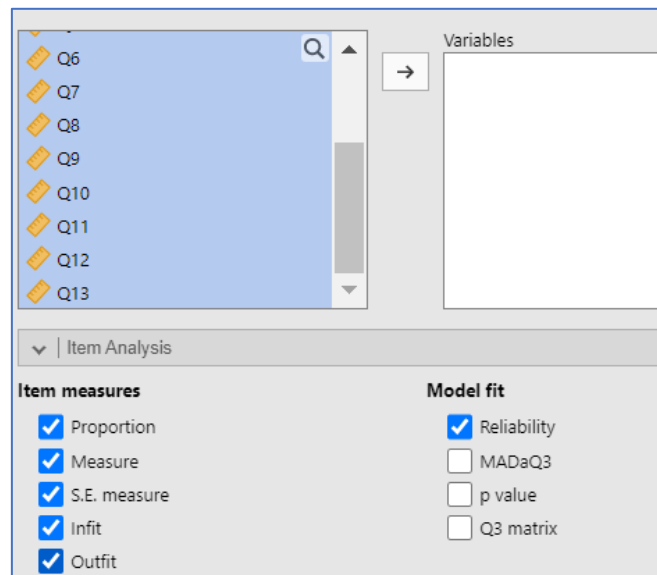

Figure 11

Rasch item statistics appeared *quickly*. See Figure 12.

Item Statistics

	Proportion	Measure	S.E.Measure	Infit	Outfit
Q1	0.79	−1.59	0.06	1.05	1.12
Q2	0.38	0.61	0.05	1.29	1.44
Q3	0.63	−0.65	0.05	0.97	0.94
Q4	0.54	−0.19	0.05	0.89	0.86
Q5	0.68	−0.95	0.05	0.88	0.79
Q6	0.47	0.16	0.05	0.89	0.88
Q7	0.63	−0.67	0.05	0.97	0.94
Q8	0.48	0.07	0.05	0.95	0.95
Q9	0.46	0.21	0.05	0.99	1.00
Q10	0.59	−0.43	0.05	0.96	0.95
Q11	0.51	−0.04	0.05	0.98	0.97
Q12	0.44	0.30	0.05	0.97	0.98
Q13	0.44	0.32	0.05	1.19	1.31

Note. Infit= Information-weighted mean square statistic; Outfit= Outlier-sensitive means square statistic.

Figure 12

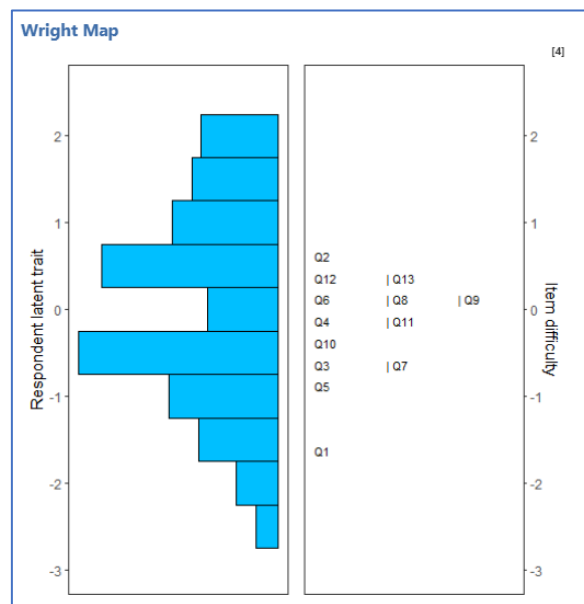I also get a <u>very</u> nicely formatted Wright Map as seen in Figure 13.

Figure 13

Under "Plots" I select "Item Characteristic Curve" for item Q1, and then get another for Q2. (There were some problems with Q2 – it appeared to be an item not highly related to the other 12, as discussed in this paper.)
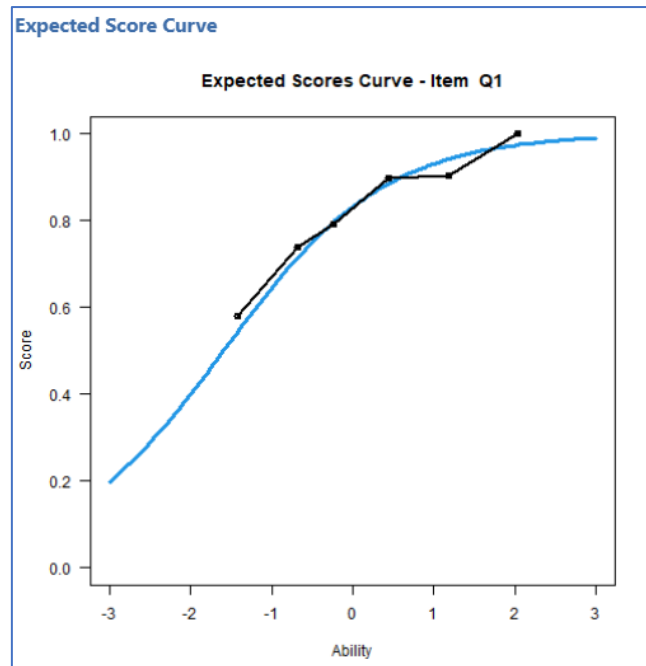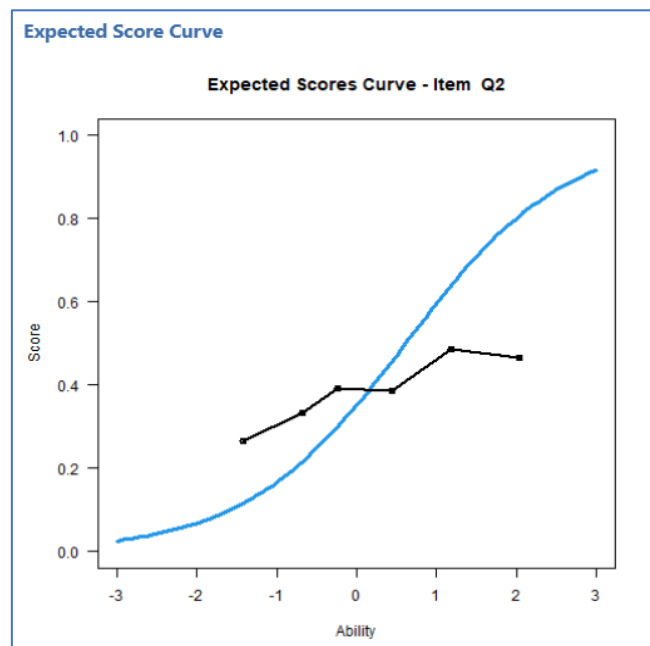
Figure 14

Figure 15

That completes what I had wanted to present.

Readers may have noted that I have taken screen snapshots and presented them above. Is it possible to get jamovi to create reports without resorting to screen shots? Yes. I have only to left-click on one of the tables or graphs to get export options.

I have now exemplified two methods for getting item results using the Rasch model. I can use the RaschAnalysis-TAM.rmd script with RStudio, and I can also use SnowIRT in jamovi. In both cases a csv file with item scores of (0,1) was needed – in my case I got the csv file using a Lertap5 option.

With the RStudio script, the incoming csv file was called OmegaIScores.csv, a file created by Lertap5's omega1macro. For SnowIRT and jamovi I made a copy of that file and called it Test13iscores2645.csv.

Which of these two approaches might I myself use with classes?

The item analysis report obtained via RStudio was saved to this file and was absolutely simple to get. I very much like that type of report as it mixes classical test theory results (CTT) with those from the Rasch IRT routine found in TAM, and this has been quite appropriate for use in my own teaching where I start students on classical test theory, and then go over to IRT/Rasch.

On the other hand, SnowIRT's Dichotomous Model (Rasch) option is interactive – students might, I think, be more likely to appreciate what's going on by having to select from menus of item analysis options. And, I find the graphics output from SnowIRT to be generally quite excellent.

Time permitting, I would use both. Lertap5's support for IRT is limited to Rasch, but not so SnowIRT where much more can be done when it comes to item response theory.