

**Bond&FoxChapter4.pdf: Bond & Fox (2006) Applying the Rasch Model ... Chapter 4: The BLOT Test**

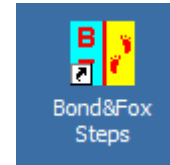
Bond's Logical Operations Test BLOT data

Skip down to **Let's remind ourselves about the BLOT test** if Bond&FoxChapter4.txt and this Tutorial are already displaying on your screen. *Please print out the Tutorial for reference.*

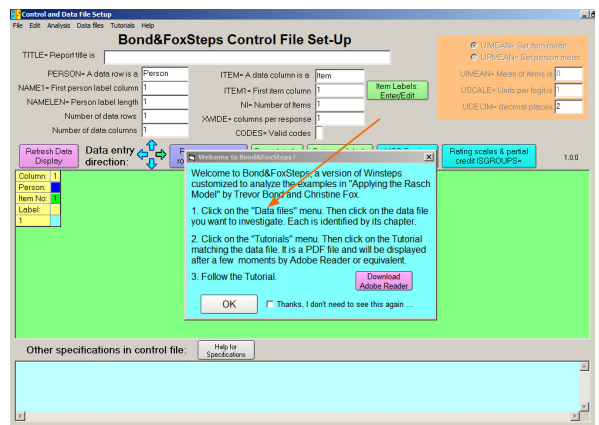
*Please install **Bond&FoxSteps** on your computer by double-clicking on **Bond&FoxStepsInstall.exe** on your CD*

```
001 11111111110110101101011111111011111
002 11111111111111111111111111110111111
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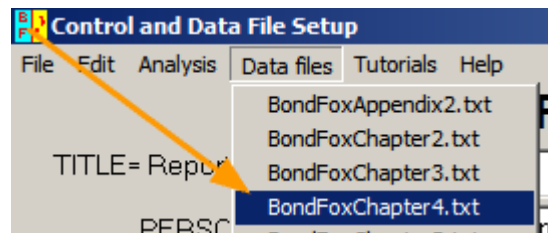
Launch Bond&FoxSteps from the short-cut on your desktop or from the Windows "Start" menu.



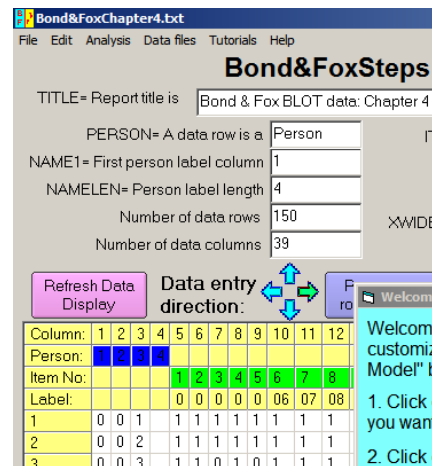
The Bond&FoxSteps Control File Set-Up Screen displays. We are going to follow the instructions in the **blue box**.



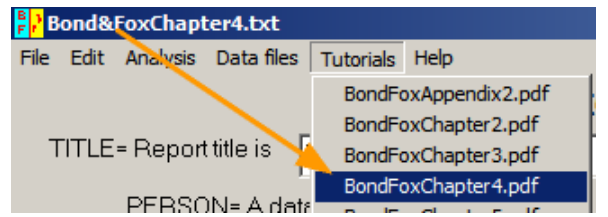
1. Click on the "Data files" menu. Click on "Bond&FoxChapter4.txt" - this is the Chapter 4 example



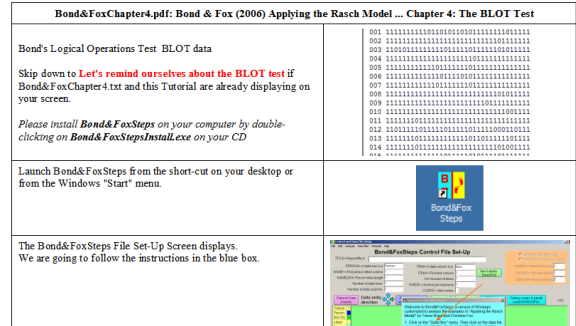
The Bond&FoxChapter4.txt control instructions and data are displayed on your screen.



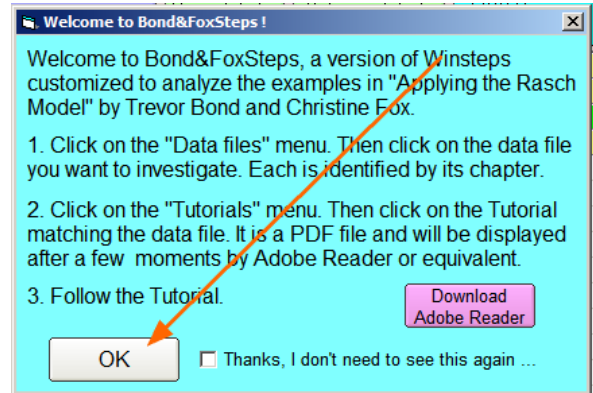
Click on the "Tutorials" menu.  
 Click on "Bond&FoxChapter4.pdf" - this is the Tutorial matching Bond&FoxChapter4.txt



This PDF file displays. It is what you are reading now. *Please print out the Tutorial for reference.*

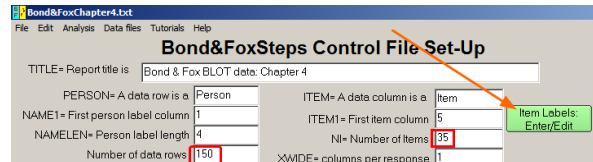


Now step-by-step through this Tutorial ...  
 Click "OK" on the Welcome dialog



**Let's remind ourselves about the BLOT test.** It consists of 35 items administered to 150 persons. It relates to Piagetian cognitive development – tapping the mature thinking that begins in adolescence for most. It is a multiple choice test, so answers are scored right (1) or wrong (0), i.e. dichotomous data.

Let's look at the item labels.  
 Click on "Item Labels Enter/Edit"



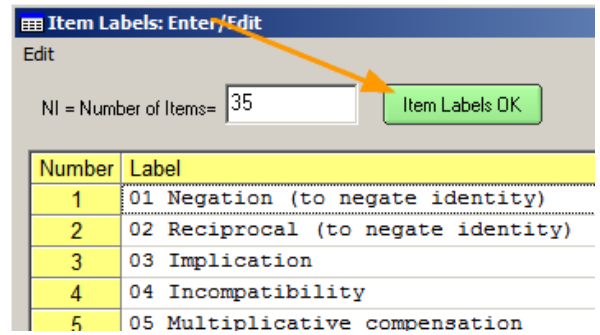
Here are some of the 35 item labels.

They are cryptic to most of us, but already far better than merely item numbers. To content experts they are highly meaningful: Inhelder & Piaget (1958) is a whole book devoted to the meaning of this system.

Number	Label
1	01 Negation (to negate identity)
2	02 Reciprocal (to negate identity)
3	03 Implication
4	04 Incompatibility
5	05 Multiplicative compensation
6	06 Correlations
7	07 Correlations
8	08 Correlations
9	09 Conjunction
10	10 Disjunction

Let's close the item label window.

Click on "Item Labels OK"

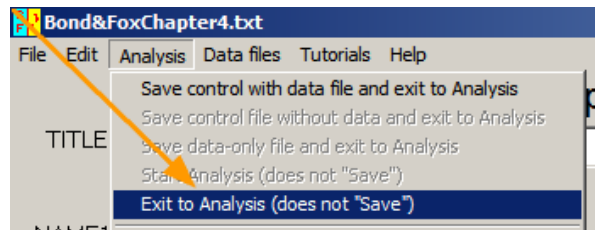


Let's perform the Analysis of these data.

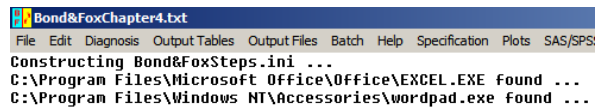
Click on "Analysis" menu

Click on "Exit to Analysis (does not Save)"

- we don't want to make any changes at this point ...



File Setup closes, and the Analysis phase begins. If this is the first time you have run an Analysis, it checks your computer for available resources ....



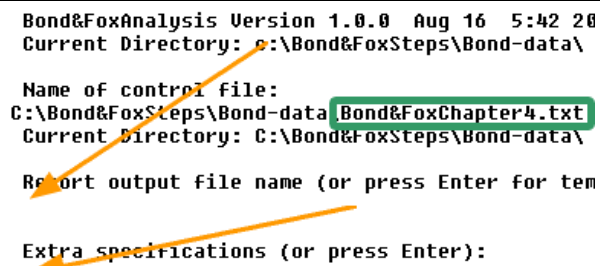
Bond&FoxSteps - Analysis phase - correctly reports that the analysis control file is Bond&FoxChapter4.txt.

"Report output file name"?

Press your Enter key

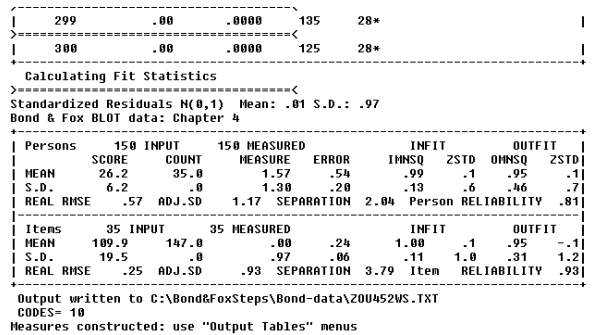
"Extra specifications"?

Press your Enter key



The BLOT data are Rasch-analyzed.

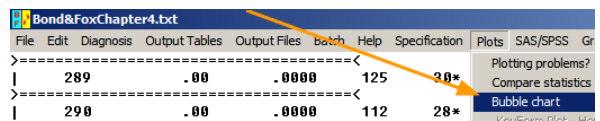
Measures (person abilities, item difficulties) are constructed.



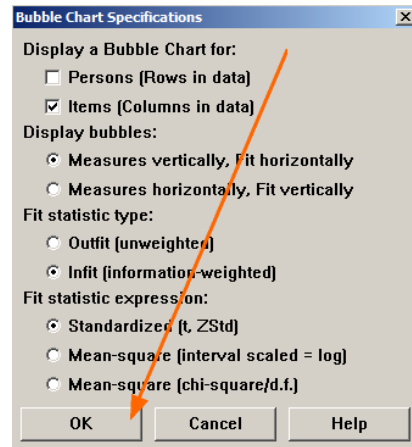
Bond & Fox Figure 4.1 Pathway Bubble chart

Click on "Plots" menu

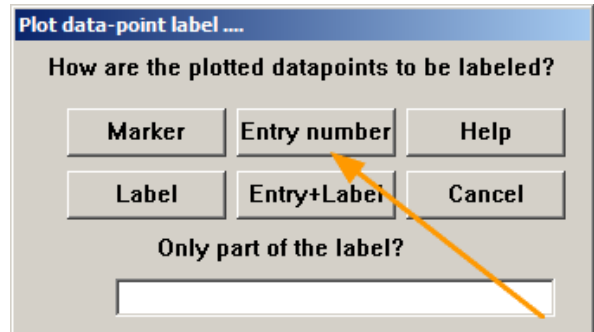
Click on "Bubble chart"



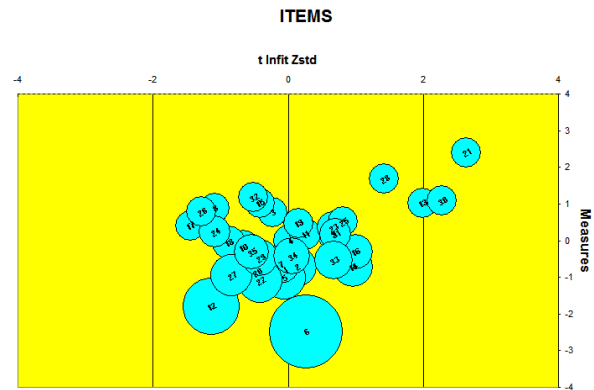
"Bubble Chart Specifications":  
 The options are correctly pre-selected, so  
 Click "OK"



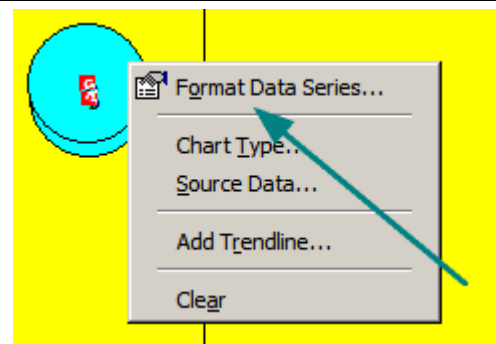
"Plot data-point label ..."?  
 Click on "Entry number"



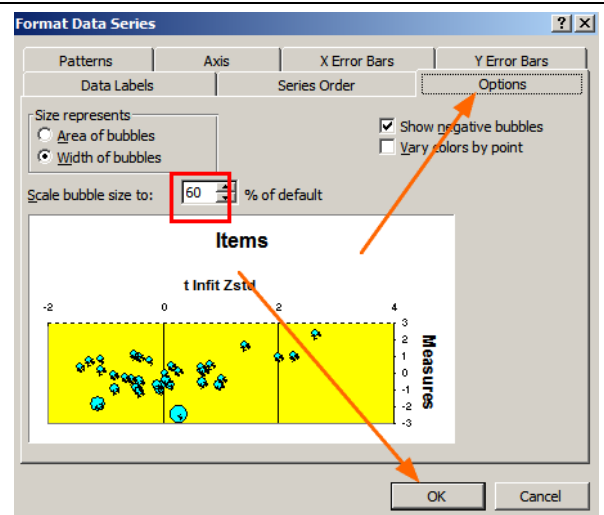
After a little delay, the Excel plot displays.  
 The bubbles are located vertically by measure and horizontally by fit.  
 The bubbles are too large. The diameter of each bubble should be twice the measure standard error. The biggest bubble should have a diameter of about 1 logit according to Table 14 (soon to come).  
 Let's use the Excel functions to correct the plot.



Right click on any bubble.  
 Click on "Format Data Series" (not "Format Data Labels" or "Format Data Points")  
 If "Format Data Series" does not display, move the mouse a little lower down in the bubble and right-click again.



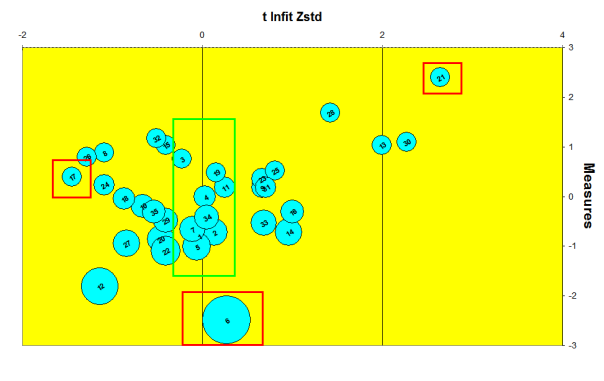
"Options" tab  
 "Scale bubble size to:" Type in "60"  
 Click on "OK"



And we see a much better looking pathway. The diameter of the biggest bubble is about 1 logit (vertically).

The most difficult item is the highest vertically. This is item 21.  
 The easiest item is the lowest vertically. This is item 6.  
 The most predictable item is the left-most item. It is item 17.  
 The least predictable item is the right-most item, again item 21.

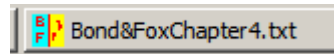
Items along the vertical 0 line exhibit the degree of predictability that accords with the Rasch model – an impossible standard for a whole test.



Close windows at any time - you can always get them again!



You can quickly get back to the Analysis by clicking on "Bond&FoxChapter4.txt" on the Windows Taskbar



The standard way of representing a Rasch-analyzed variable has come to be known as a "Wright map" (named after Benjamin D. Wright of the University of Chicago, for forty years the leading advocate of Rasch measurement). Other names are "variable map" or "item-person map".

**Bond & Fox Figure 4.2 Item map** is one such map.  
 Click on the "Output Tables" pull-down menu  
 Click on "12. ITEM: Map".

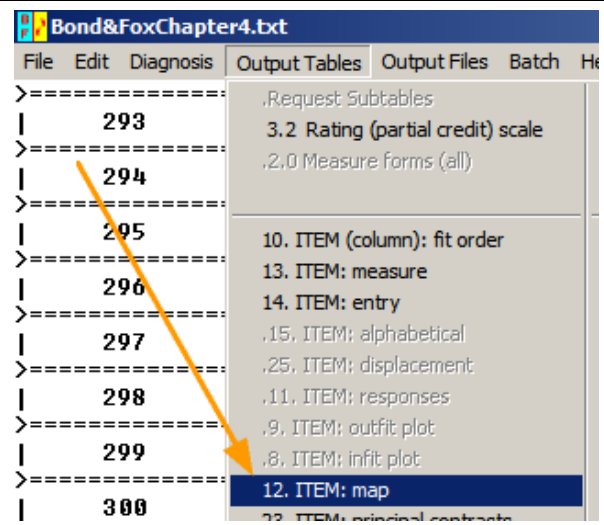




Table 13 is displayed by WordPad.  
It shows the same item statistics: scores, measures, standard errors and fit statistics, but this time the items are ordered by difficulty, so they will match the representation of the BLOT items on the Pathway plot and the Wright map.

Item 21 has the lowest score, so it is the most difficult item with a difficulty measure of 2.40 logits.

TABLE 13.1 Bond & Fox BLOT data: Chapter 4 ZOU452WS.T  
INPUT: 150 Persons 35 Items MEASURED: 150 Persons 35 Item

Person: REAL SEP.: 2.04 REL.: .81 ... Item: REAL SEP.: 3.79

Item STATISTICS: MEASURE ORDER

ENTRY NUMBER	TOTAL SCORE	COUNT	MEASURE	MODEL S.E.	INFIT MNSQ	OUTFIT ZSTD	INFIT MNSQ	OUTFIT ZSTD
21	54	150	2.40	.20	1.27	2.6	1.75	3.7
28	73	150	1.68	.19	1.12	1.4	1.23	1.7
32	87	150	1.17	.19	.96	-.5	.85	-1.1
30	89	150	1.10	.19	1.19	2.3	1.15	1.0

### Bond & Fox Summary of Item Estimates

Click on the "Output Tables" pull-down menu  
Click on "3.1 Summary statistics".

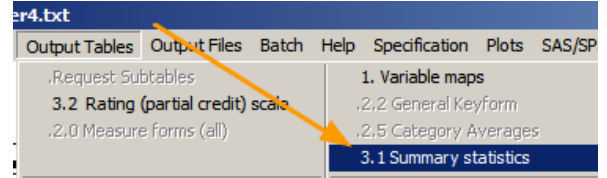


Table 3.1 displays.

The first panel shows summary statistics for the non-extreme persons. Extreme persons are those with zero and perfect scores. They are omitted from this panel.

We'll look at these in a moment.

TABLE 3.1 Bond & Fox BLOT data: Chapter 4 ZOU452WS.TXT Aug 22 17:14 2006  
INPUT: 150 Persons 35 Items MEASURED: 150 Persons 35 Items 2 CATS 1.0.

SUMMARY OF 147 MEASURED (NON-EXTREME) PERSONS

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	OUTFIT ZSTD	INFIT MNSQ	OUTFIT ZSTD
MEAN	26.2	35.0	1.57	.52	.99	.1	.95	.1
S.D.	6.2	.0	1.30	.20	.13	.6	.46	.7
MAX.	34.0	35.0	3.95	1.03	1.31	1.6	4.48	2.7
MIN.	5.0	35.0	-2.09	.37	.70	-1.5	.16	-1.4

REAL RMSE .57 ADJ.SD 1.17 SEPARATION 2.04 PERSON RELIABILITY .81  
MODEL RMSE .56 ADJ.SD 1.17 SEPARATION 2.09 PERSON RELIABILITY .81  
S.E. OF PERSON MEAN = .11

MAXIMUM EXTREME SCORE: 3 Persons

Scroll down to "SUMMARY OF 35 MEASURED (NON-EXTREME) ITEMS"

Table 3.1 matches the Bond & Fox summary with 35 items.  
If there were items with zero or perfect scores, their counts would be given at the bottom of Table 3.1

SUMMARY OF 35 MEASURED (NON-EXTREME) ITEMS

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	OUTFIT ZSTD	INFIT MNSQ	OUTFIT ZSTD
MEAN	109.9	147.0	.00	.24	1.00	.1	.95	-1.1
S.D.	19.5	.0	.97	.05	.11	1.0	.51	1.2
MAX.	142.0	147.0	2.40	.47	1.27	2.6	1.75	3.7
MIN.	51.0	147.0	-2.49	.19	.69	-1.4	.24	-1.6

REAL RMSE .25 ADJ.SD .93 SEPARATION 3.79 ITEM RELIABILITY .93  
MODEL RMSE .24 ADJ.SD .93 SEPARATION 3.86 ITEM RELIABILITY .94  
S.E. OF ITEM MEAN = .17

### Bond & Fox Summary of Case Estimates

Scroll back up to the top of Table 3.1

Since there are persons with maximum scores (in fact 3 of them), two sets of summary results are displayed: with and without extreme scores.

Look at the 147 non-extreme persons. They closely match the Bond & Fox table. The person reliability is the familiar "Test Reliability".

TABLE 3.1 Bond & Fox BLOT data: Chapter 4 ZOU452WS.TXT Aug 22 17:14 2006  
INPUT: 150 Persons 35 Items MEASURED: 150 Persons 35 Items 2 CATS 1.0.

SUMMARY OF 147 MEASURED (NON-EXTREME) PERSONS

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	OUTFIT ZSTD	INFIT MNSQ	OUTFIT ZSTD
MEAN	26.2	35.0	1.57	.52	.99	.1	.95	.1
S.D.	6.2	.0	1.30	.20	.13	.6	.46	.7
MAX.	34.0	35.0	3.95	1.03	1.31	1.6	4.48	2.7
MIN.	5.0	35.0	-2.09	.37	.70	-1.5	.16	-1.4

REAL RMSE .57 ADJ.SD 1.17 SEPARATION 2.04 PERSON RELIABILITY .81  
MODEL RMSE .56 ADJ.SD 1.17 SEPARATION 2.09 PERSON RELIABILITY .81  
S.E. OF PERSON MEAN = .11

MAXIMUM EXTREME SCORE: 3 Persons

Scroll down to the second panel.

This shows statistics for all 150 persons. The Rasch person reliability is .80, but the Cronbach Alpha reliability is .88. As [www.rasch.org/rmt/rmt1131.htm](http://www.rasch.org/rmt/rmt1131.htm) demonstrates, Cronbach Alpha routinely *overstates* reliability, and Rasch reliability *understates* it.

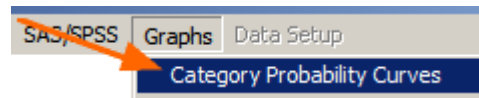
SUMMARY OF 150 MEASURED (EXTREME AND NON-EXTREME) PERSONS

	RAW SCORE	COUNT	MEASURE	MODEL ERROR	INFIT MNSQ	OUTFIT ZSTD	INFIT MNSQ	OUTFIT ZSTD
MEAN	26.3	35.0	1.64	.55				
S.D.	6.3	.0	1.38	.27				
MAX.	35.0	35.0	5.21	1.84				
MIN.	5.0	35.0	-2.09	.37				

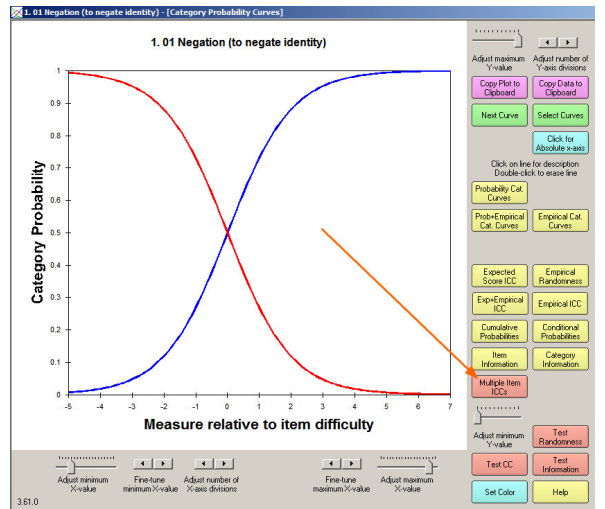
REAL RMSE .62 ADJ.SD 1.24 SEPARATION 1.98 PERSON RELIABILITY .80  
MODEL RMSE .61 ADJ.SD 1.24 SEPARATION 2.03 PERSON RELIABILITY .80  
S.E. OF PERSON MEAN = .11

PERSON RAW SCORE-TO-MEASURE CORRELATION = .95  
CRONBACH ALPHA (KR-20) PERSON RAW SCORE RELIABILITY = .88

Bond & Fox Fig. 4.4 shows the model item characteristic curves for 3 BLOT items. Let's recreate them.  
 Back to the Analysis screen.  
 Click on "Graphs" menu  
 Click on "Category Probability Curves"

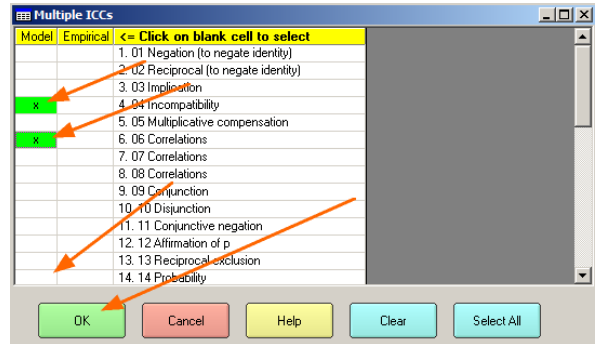


The probability curves for Item 1 display. The red line is the Rasch-model probability of scoring 0 and the blue line is the Rasch-model probability of scoring 1.



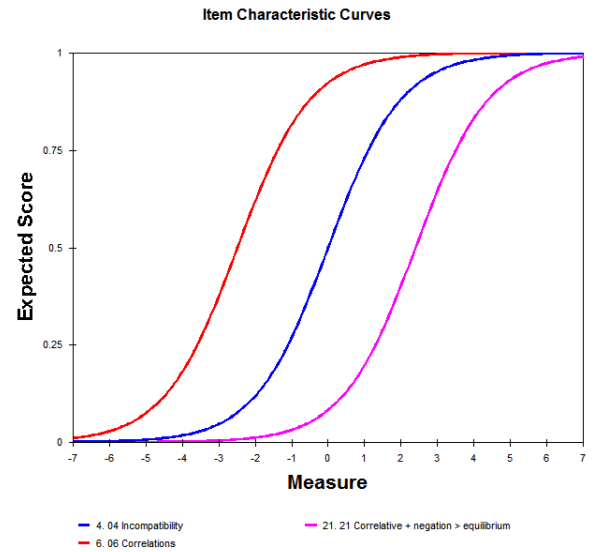
Click on "Multiple Item ICCs"

Click on the "Model" cells for item 4, 6. Scroll down and click item 21. The cells turn green with an x in them.



Then click "OK"

Three model item characteristic curves display.



Close all open and output windows

