

**Cerebrals Cognitive Ability Tests**  
**Psychometric Properties**

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**The Cerebrals Society**

DRAFT VERSION  
Saturday, 13 September 2008

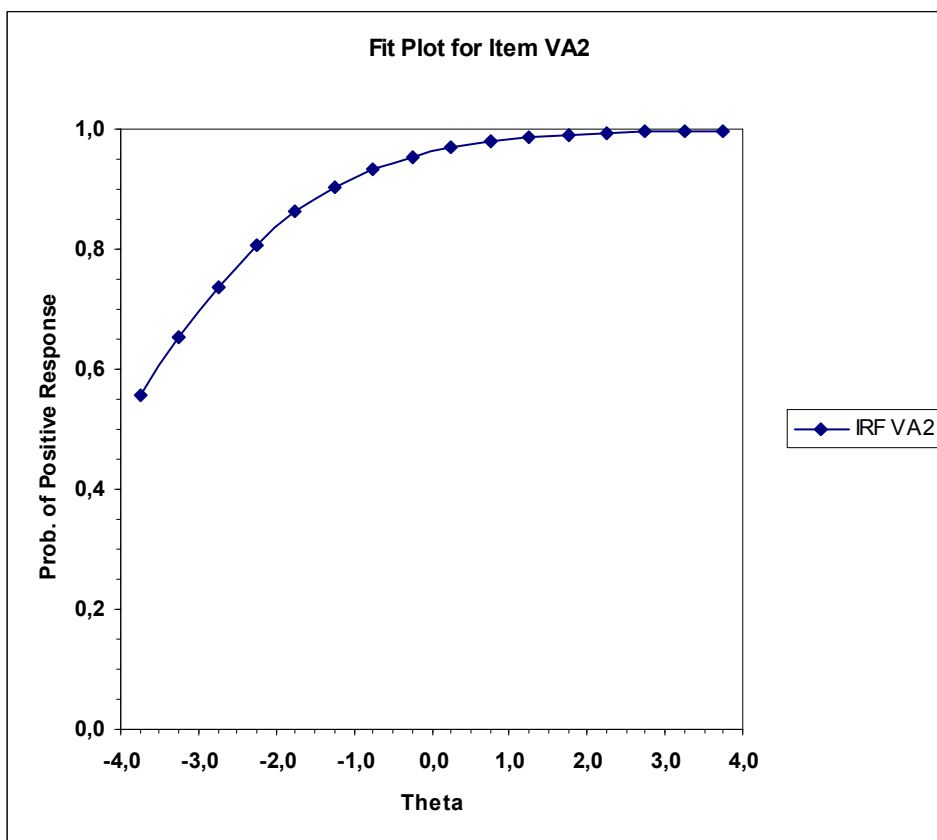
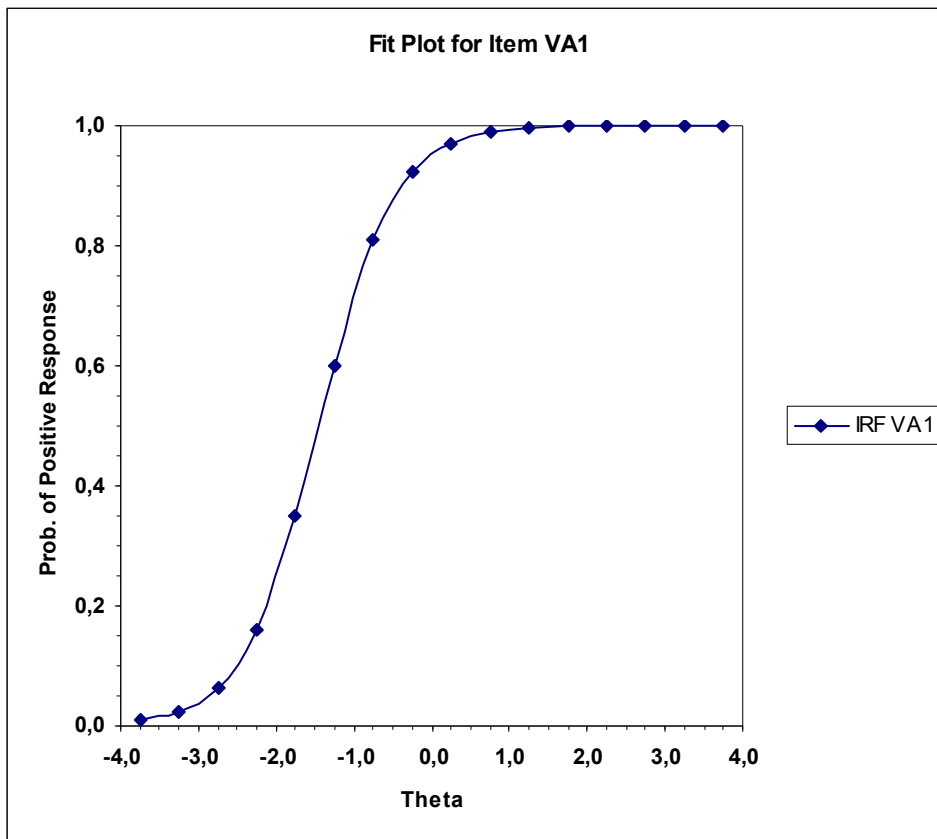
## ***Item Response Theory***

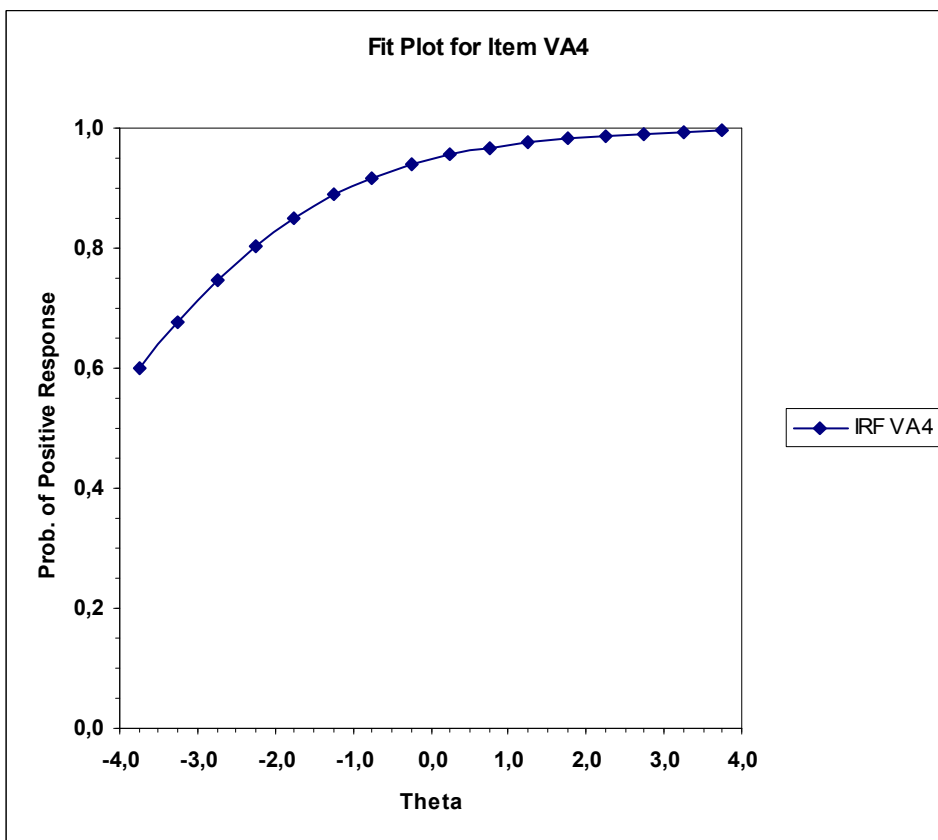
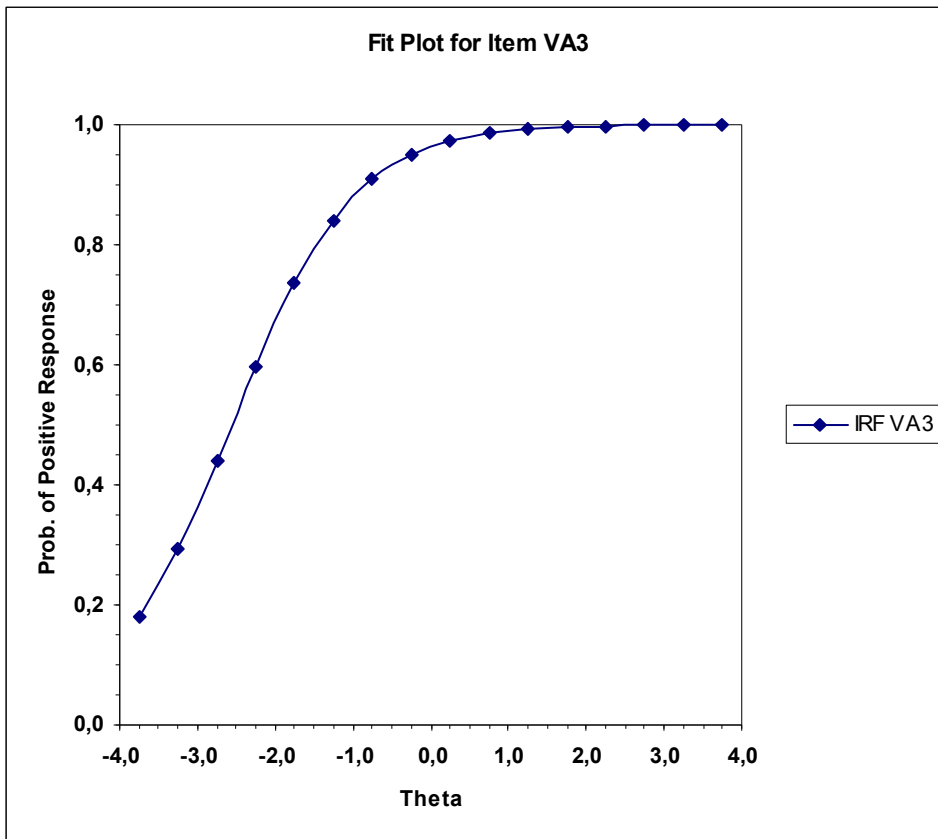
**Table 1 - Common Factor Model Reparameterization Item Loadings for Own Subtest Factor**

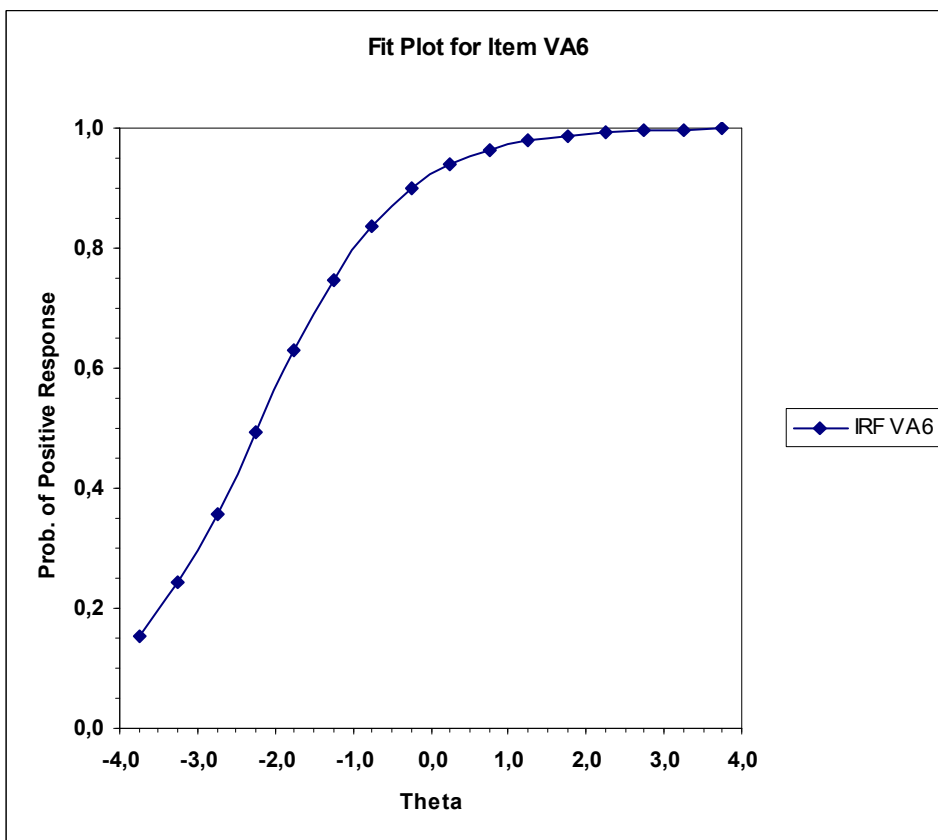
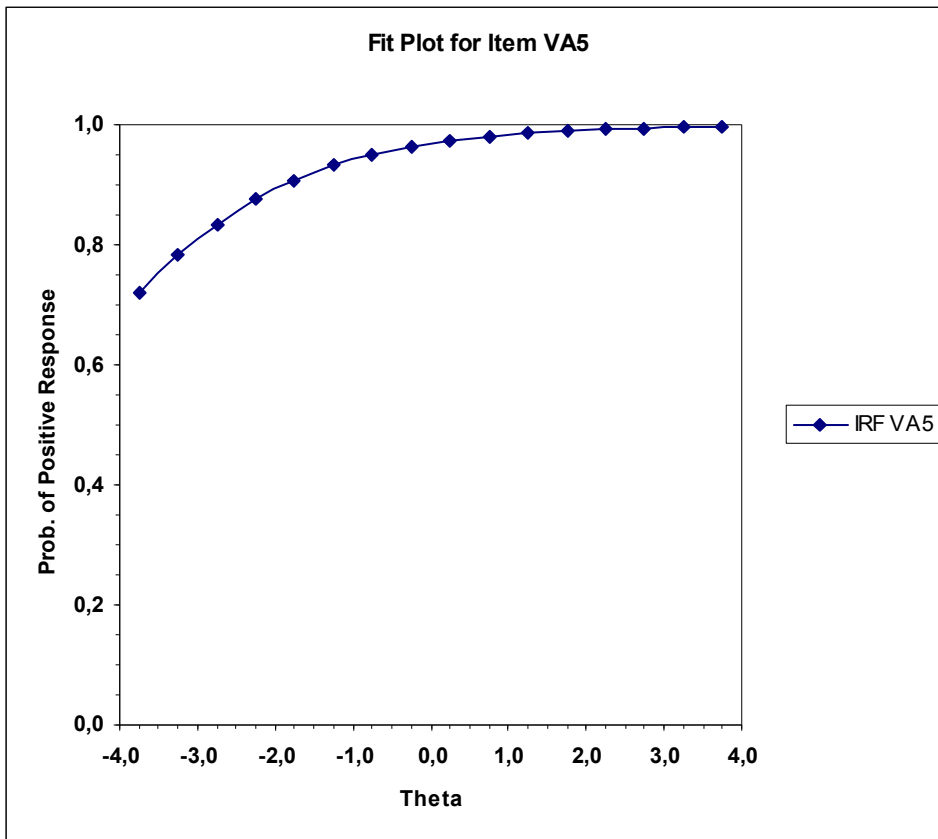
<b>Item Number</b>	<b>Verbal Analogies Factor Loadings</b>	<b>Math. Problems Factor Loadings</b>	<b>General Knowledge Factor Loadings</b>
1	.772	.638	.429
2	.426	.720	.595
3	.599	.610	.349
4	.364	.712	.577
5	.366	.847	.724
6	.547	.834	.720
7	.557	.739	.717
8	.575	.618	.705
9	.643	.704	.560
10	.318	.627	.629
11	.389	.788	.799
12	.481	.547	.654
13	.688	.624	.775
14	.335	.795	.569
15	.662	.642	.766
16	.505	.375	.561
17	.545	.796	.703
18	.438	.472	.826
19	.402	.690	.731
20	.419	.617	.525
21	.173	.777	.714
22	.315	.621	.703
23	.314	.633	.671
24	.219	.787	.535
25	.427	.768	.699
26	.498	.734	.784
27	.540	.561	.780
28	.173	.637	.661
29	.359	.639	.745
30	.419	.530	.727
31	.537	.548	.703
32	.591	.442	.633
33	.486	.654	.496
34	.503	.646	.766
35	.514	.659	.779
36	.243	.686	.696
37	.592	.647	.494
38	.995	.636	.600
39	.632		.715
40	.644		.726
41	.999		.668
42	.578		.531
43			.699
44			.833
45			.524
46			.593
47			.581

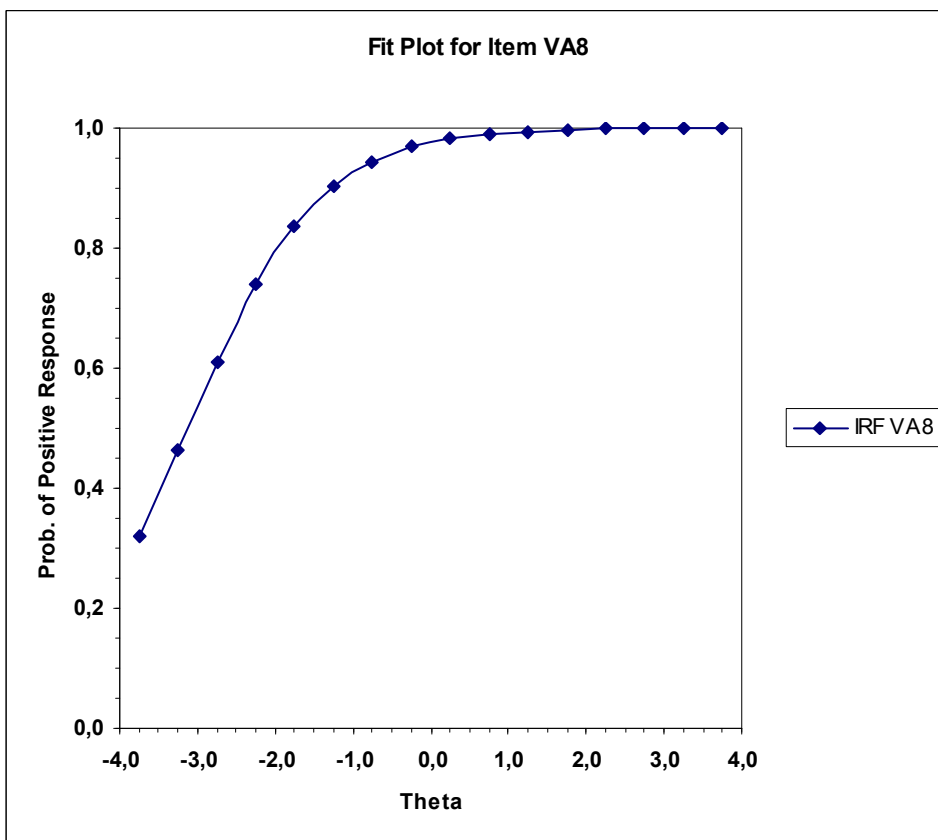
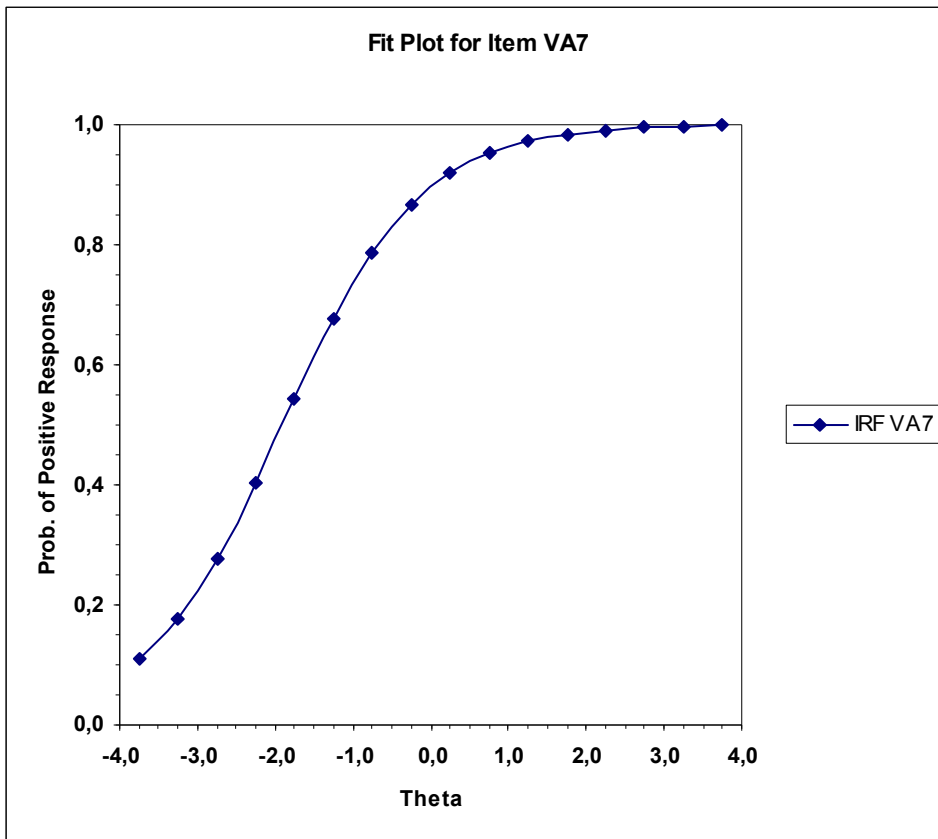
<b>Item Number</b>	<b>Verbal Analogies Factor Loadings</b>	<b>Math. Problems Factor Loadings</b>	<b>General Knowledge Factor Loadings</b>
48			.642
49			.417
50			.398
51			.698
52			.524
53			.563
54			.812
55			.506
56			.413

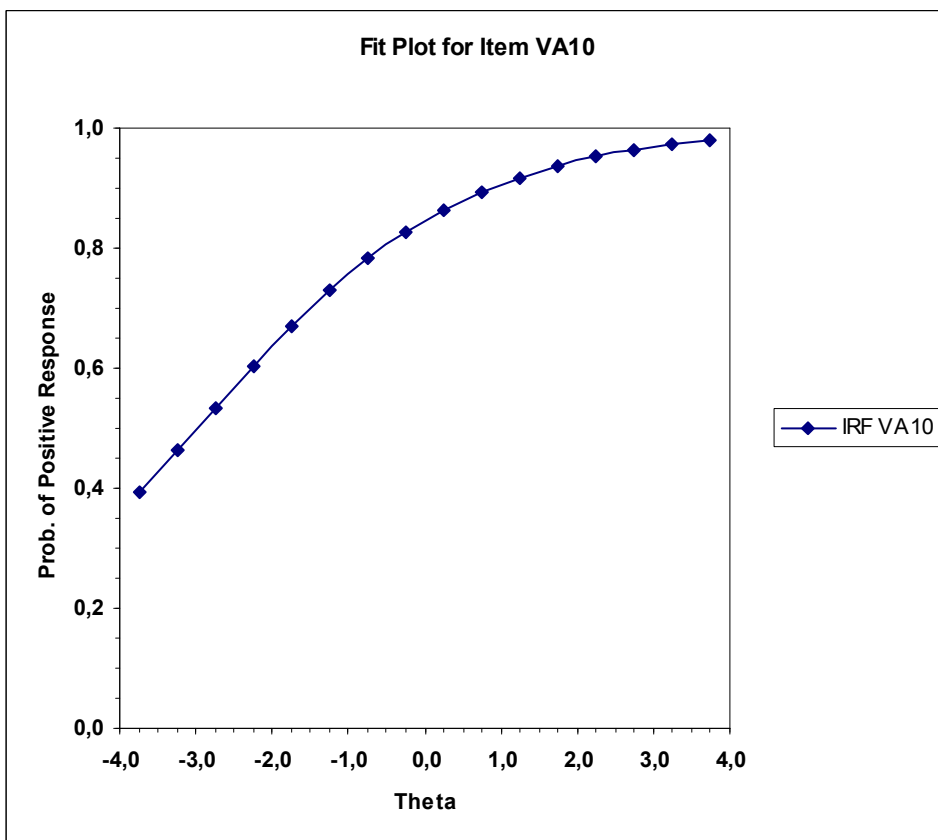
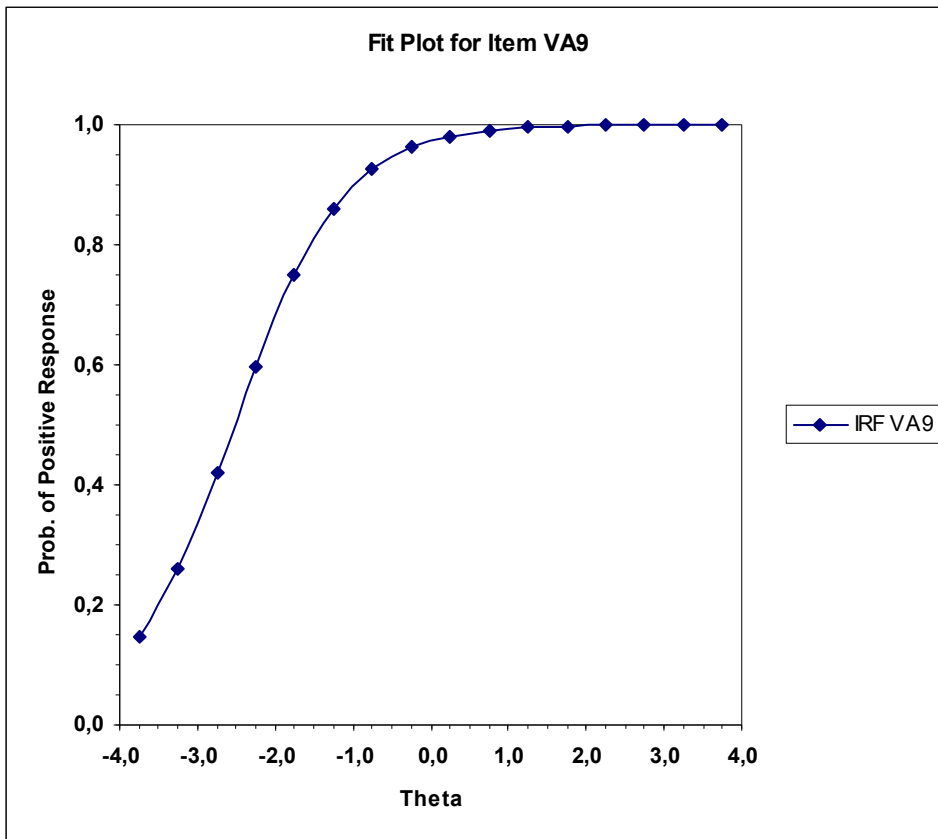
## Verbal Analogies ICC

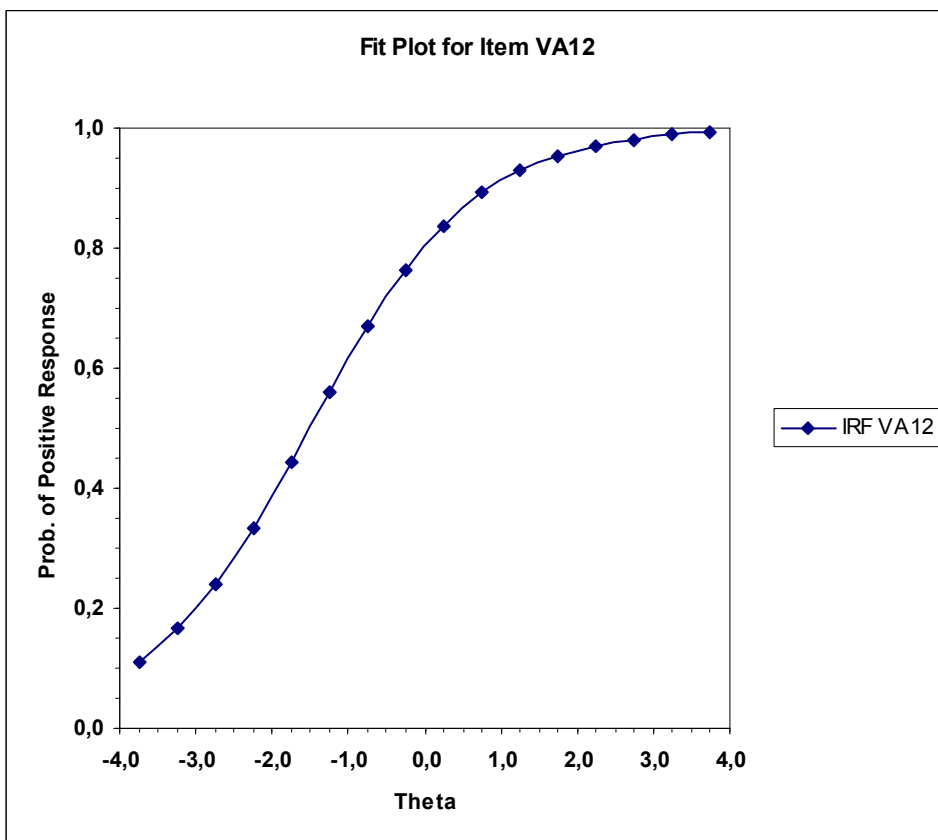
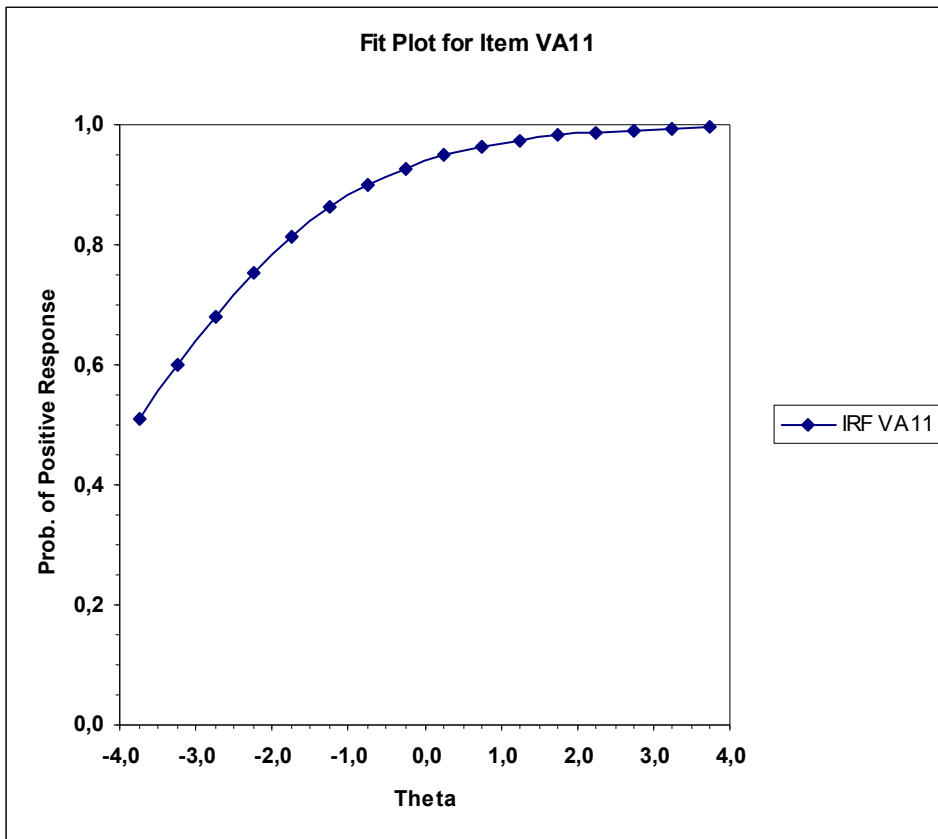


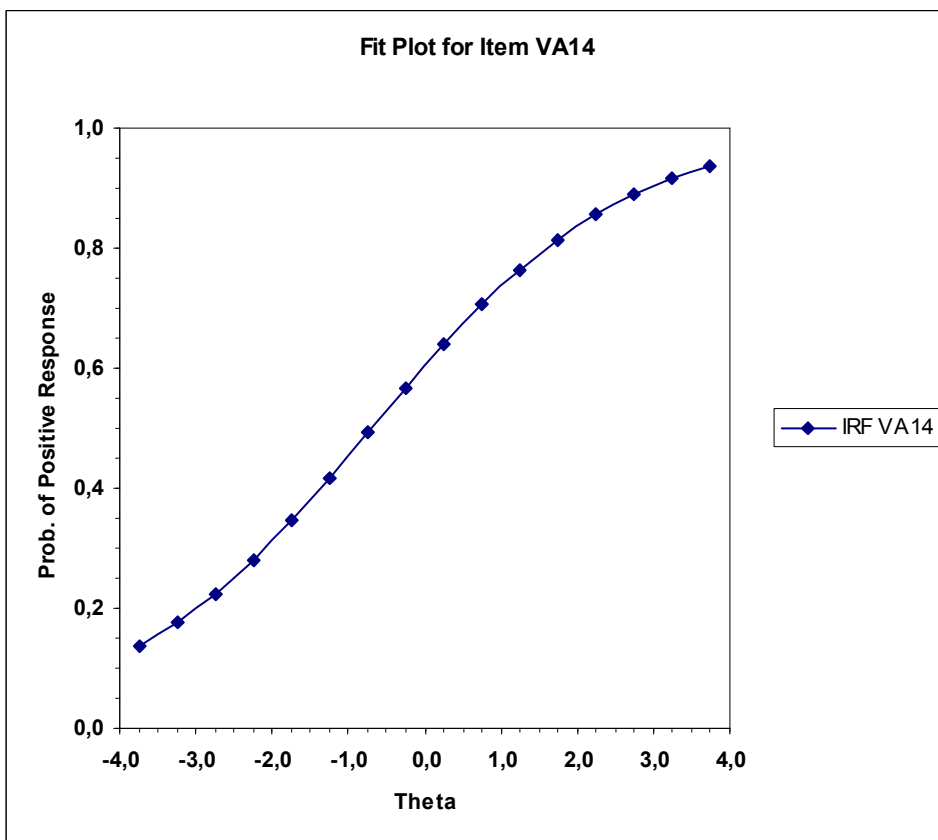
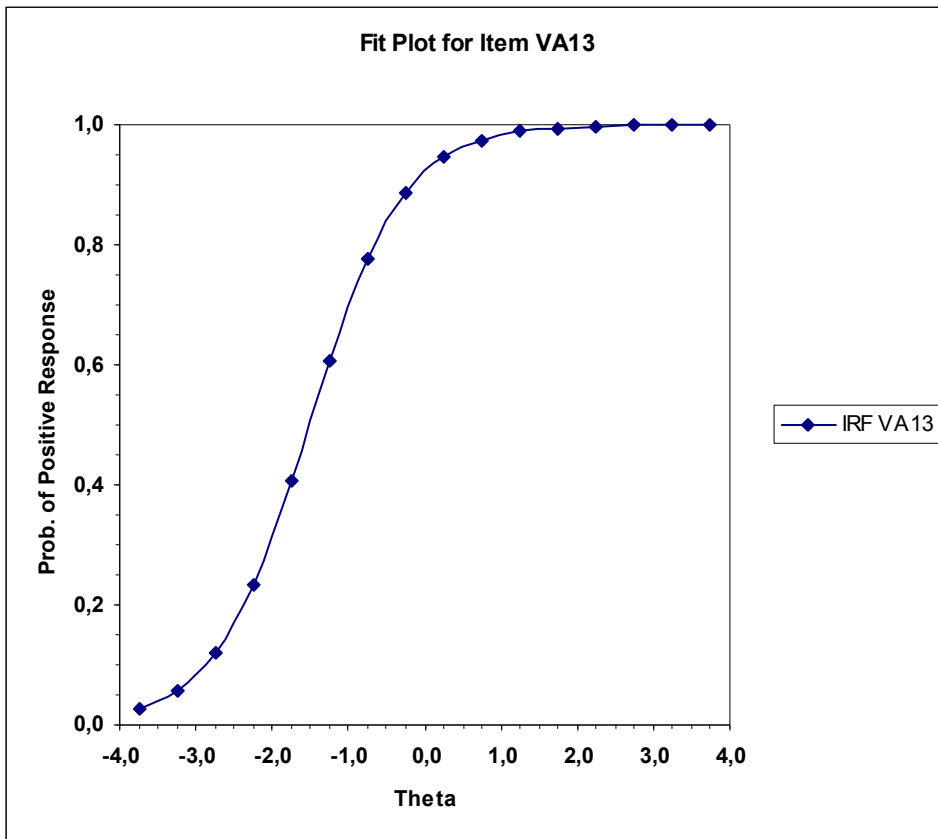


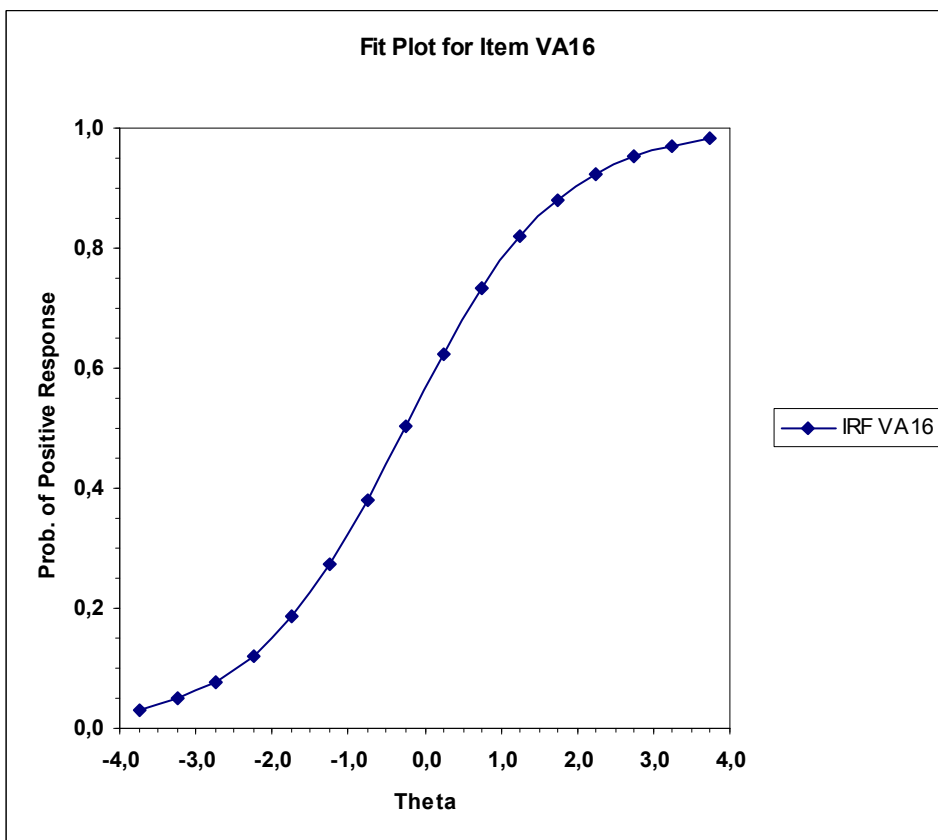
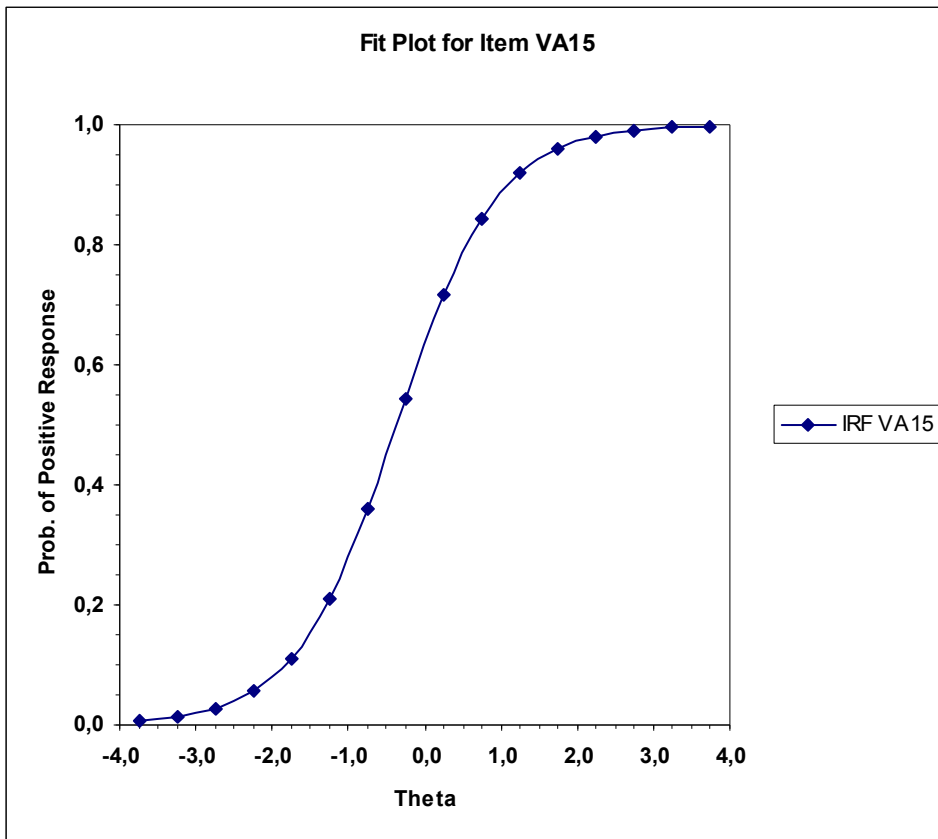


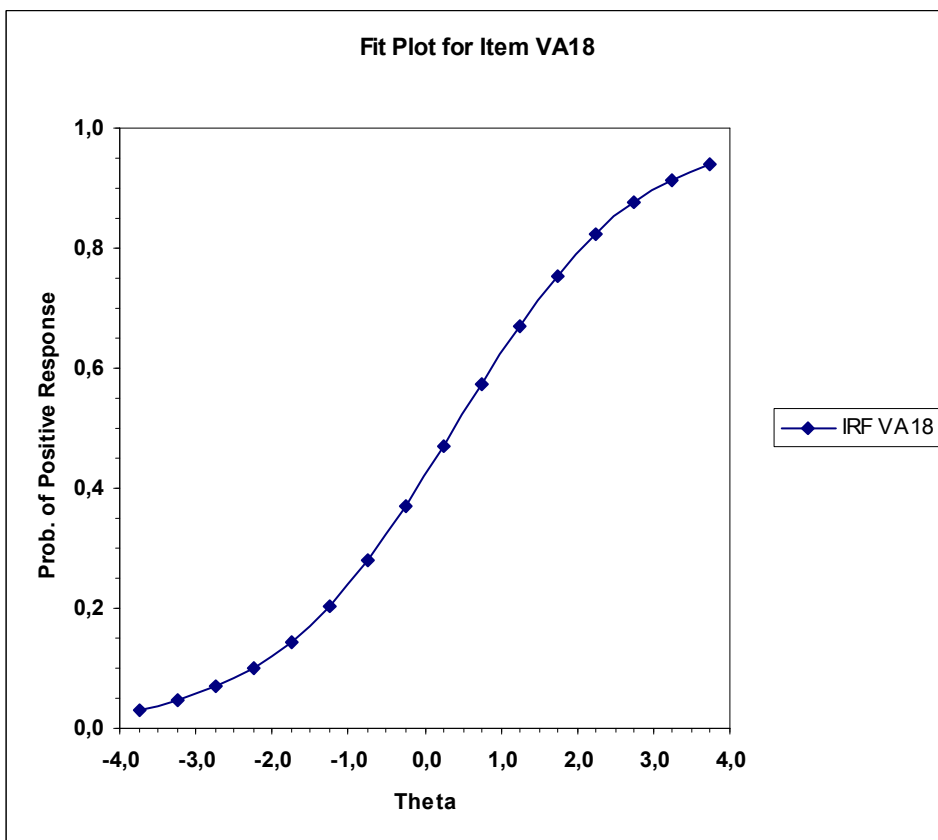
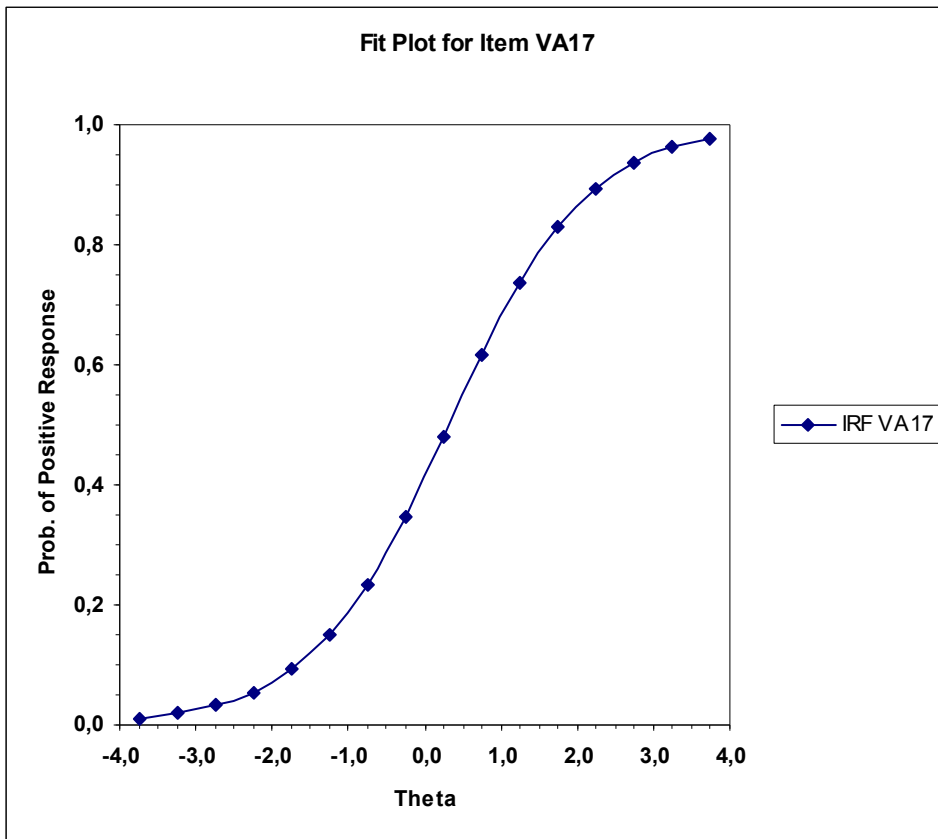


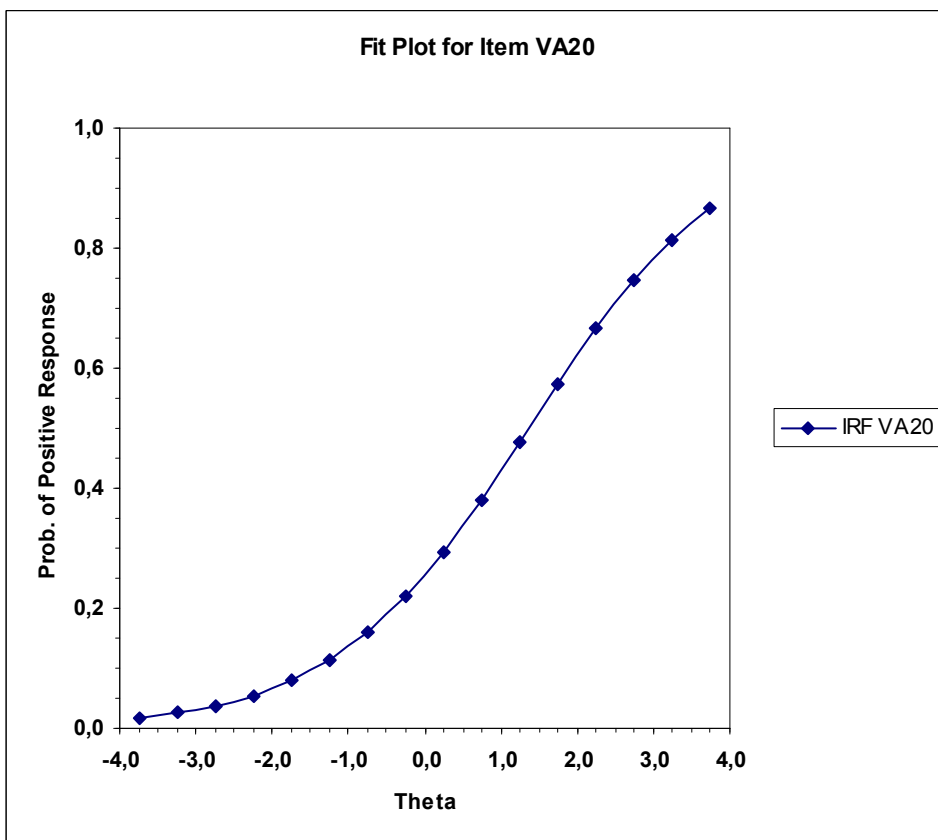
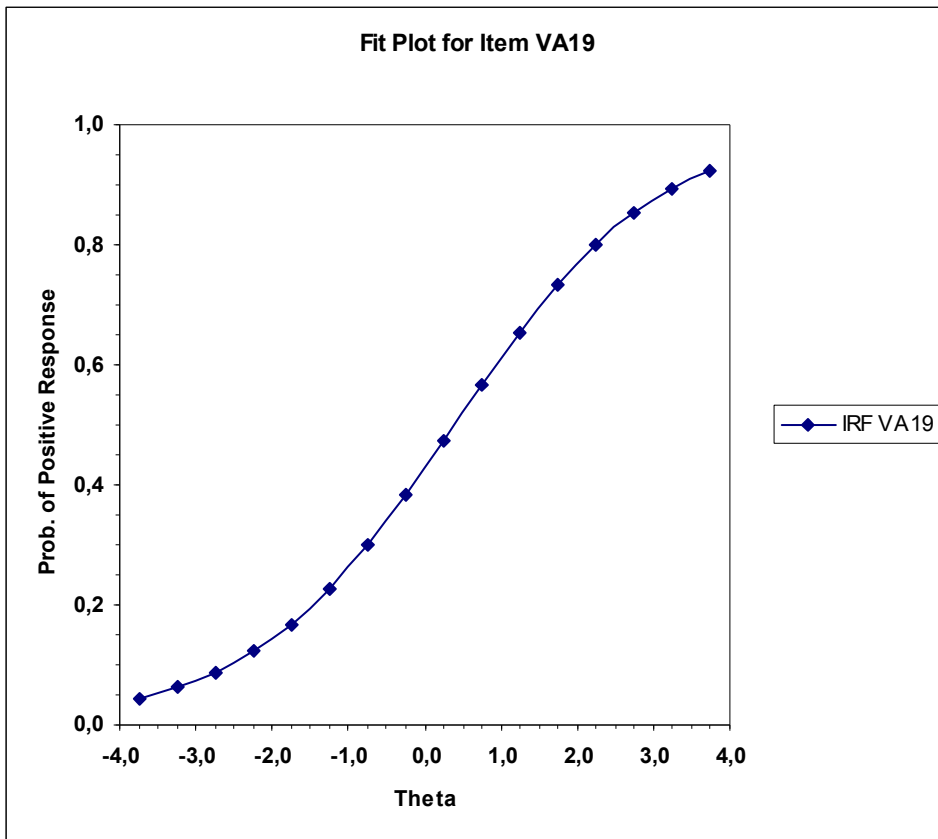


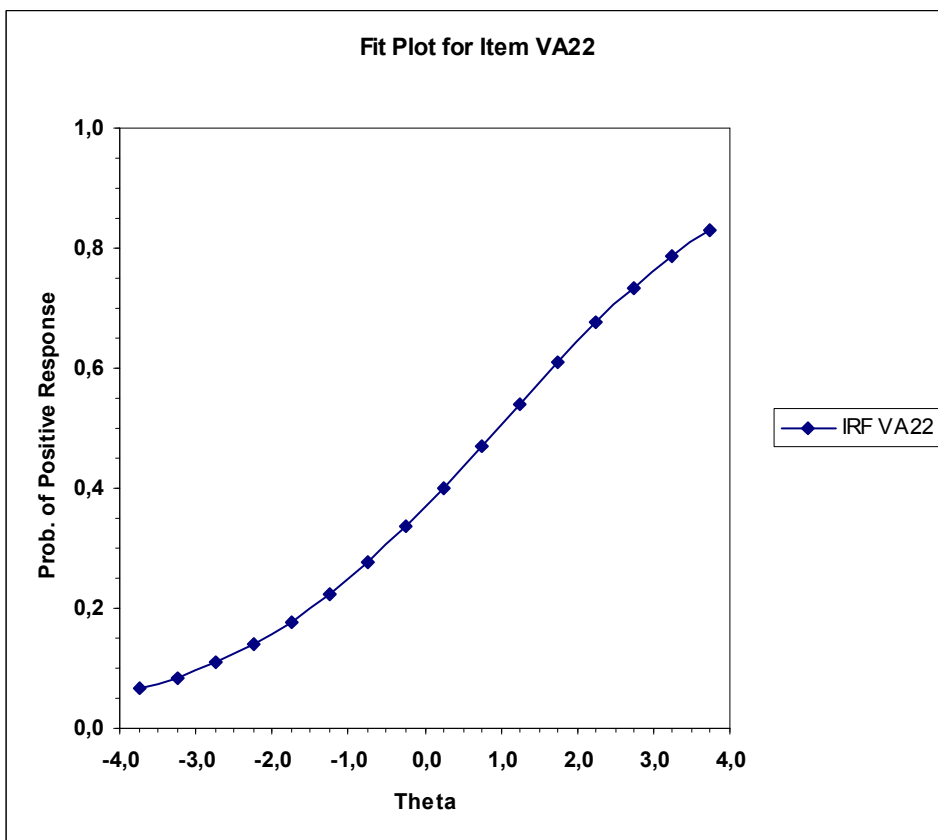
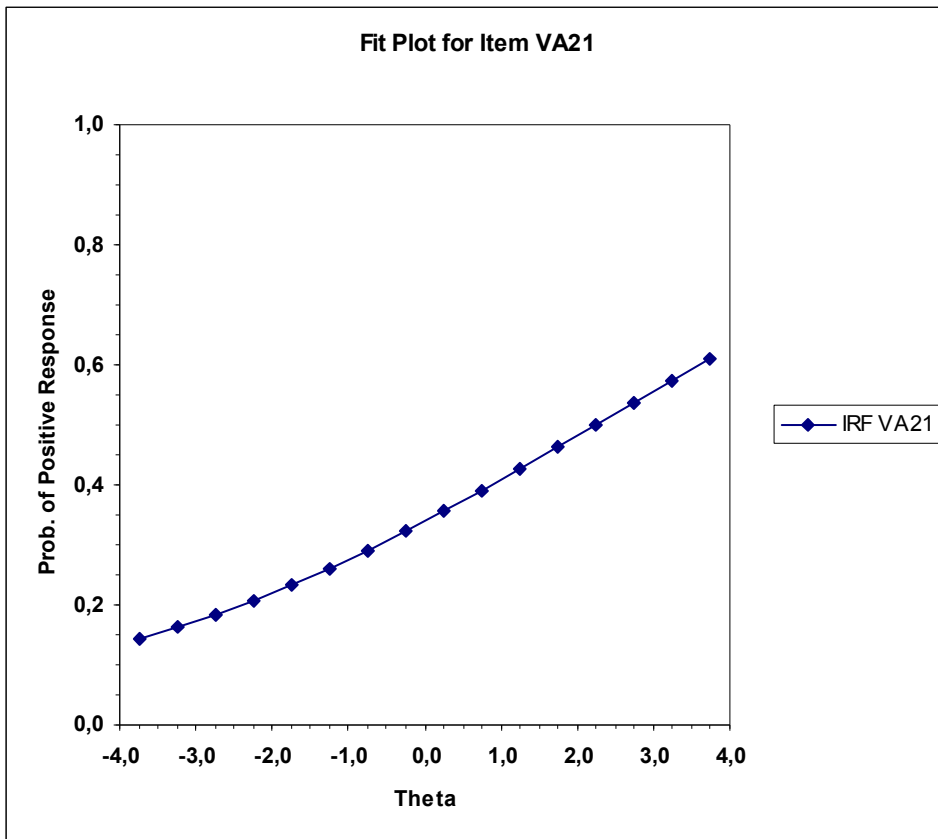


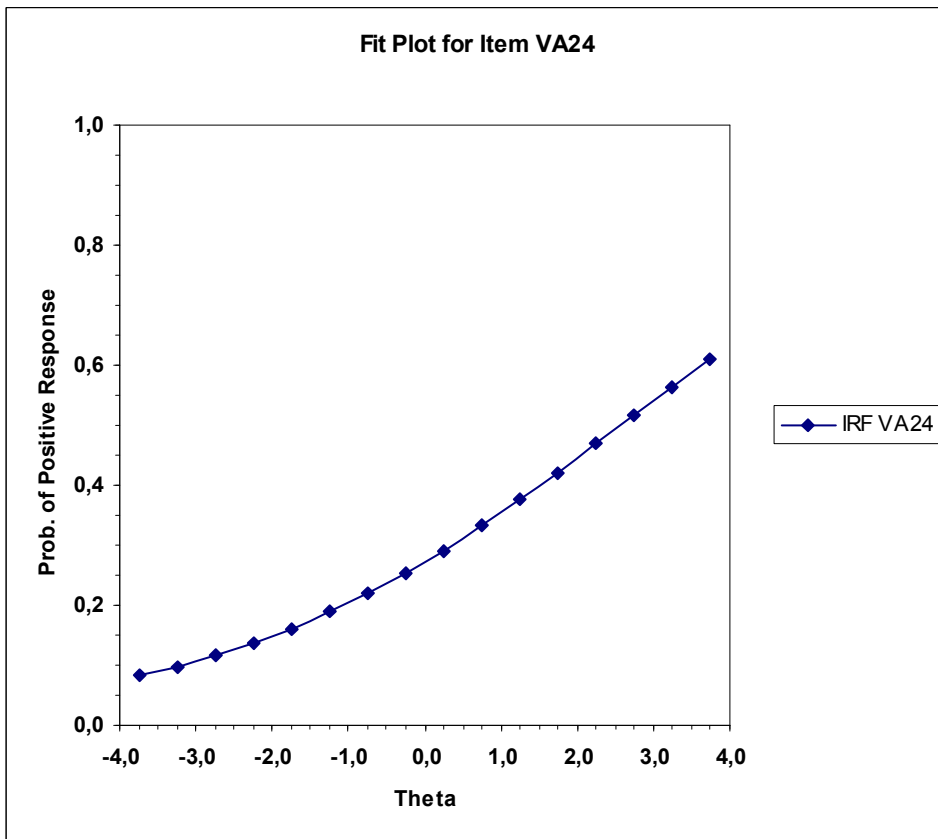
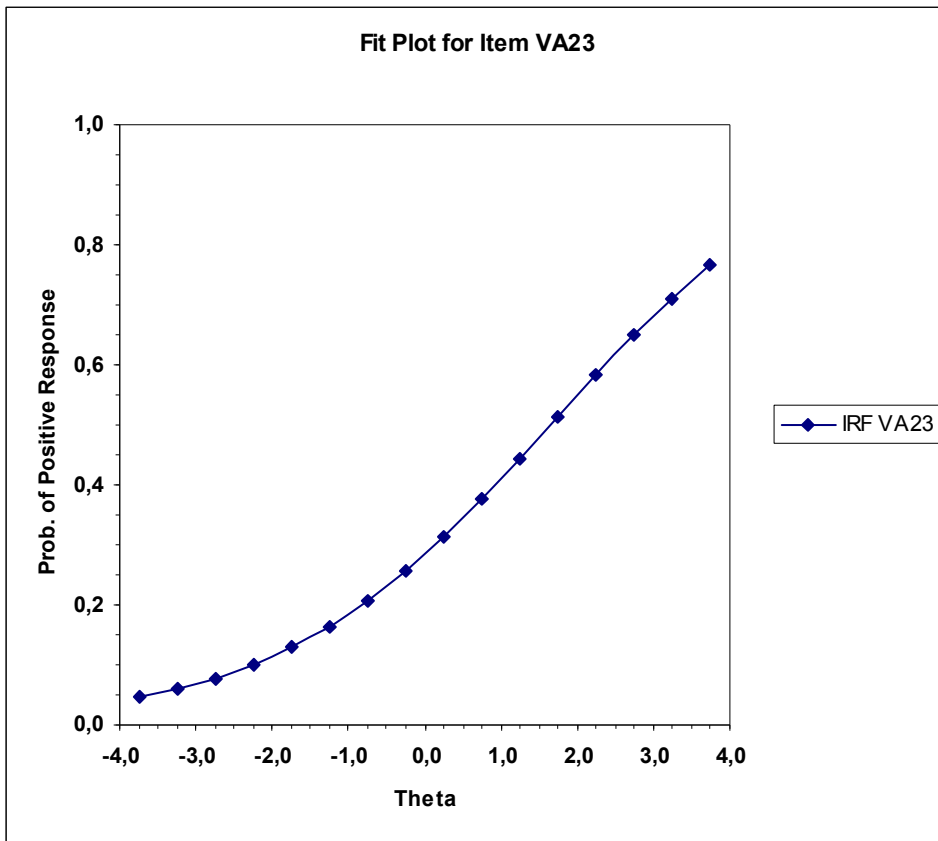


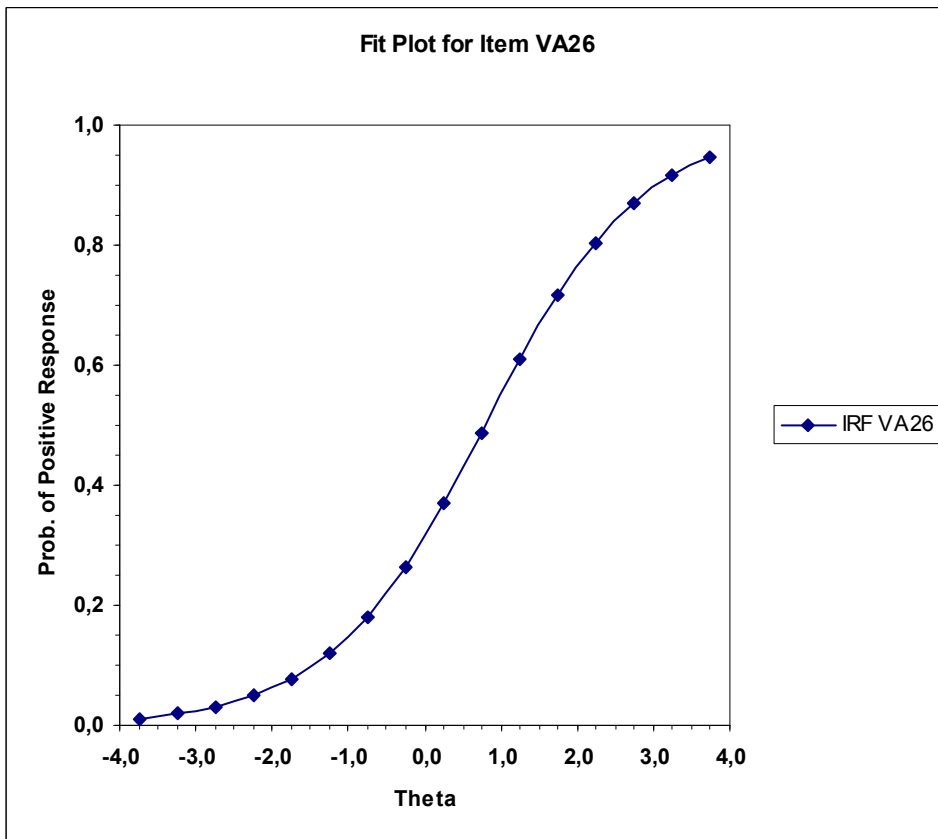
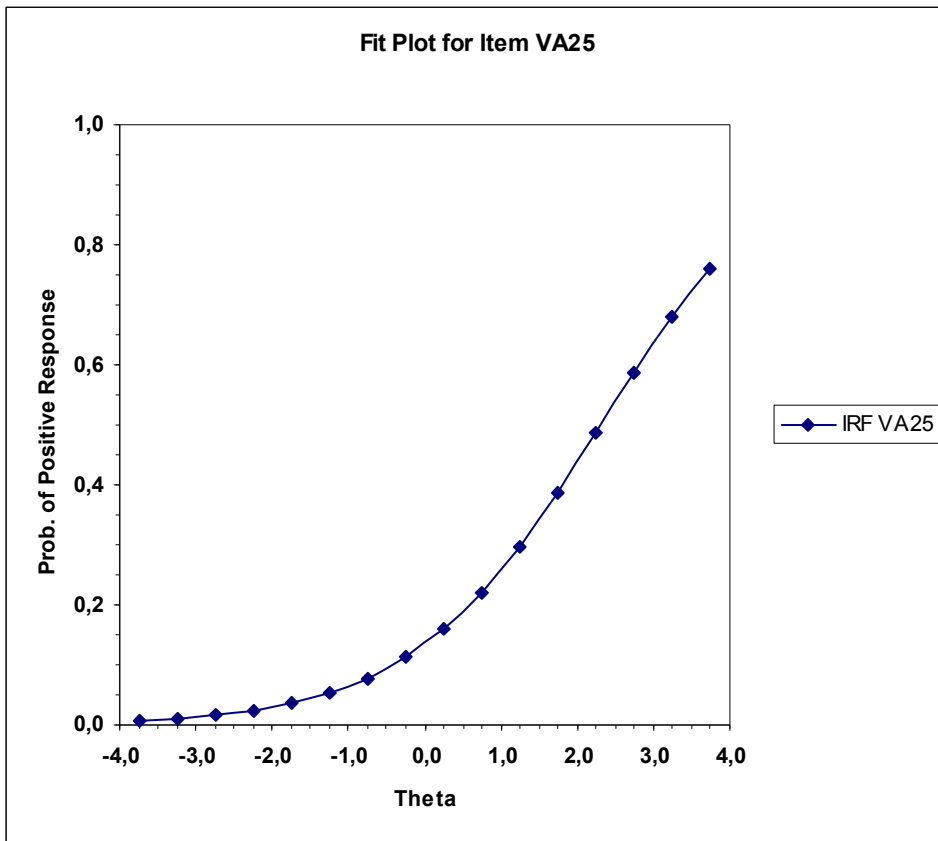


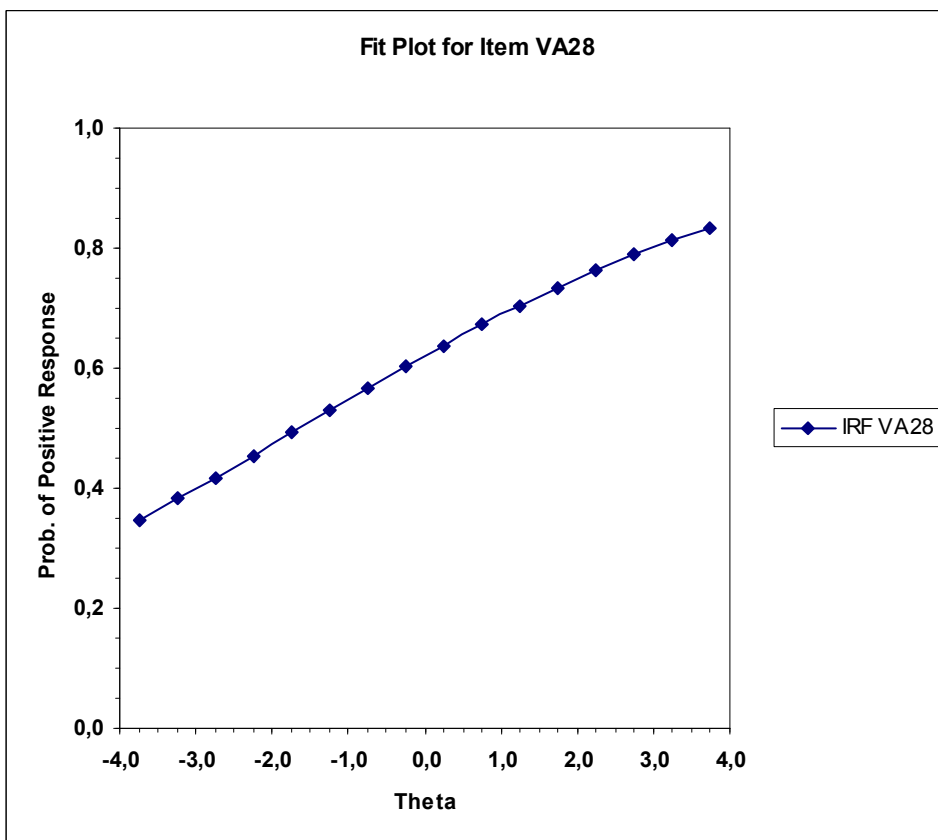
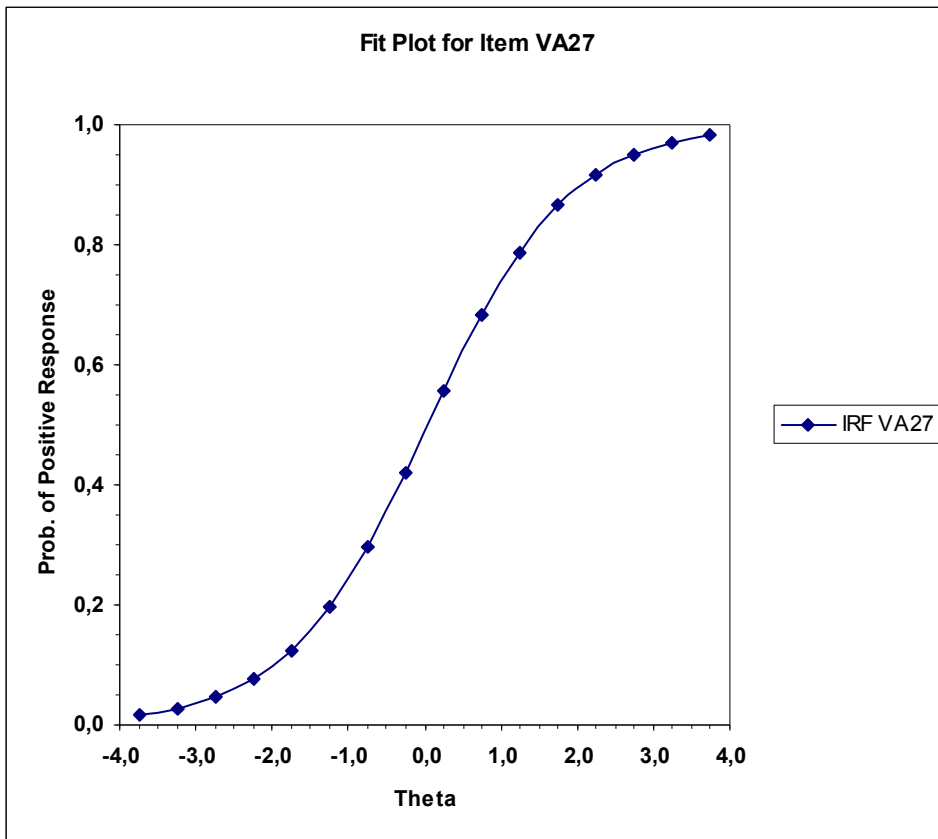


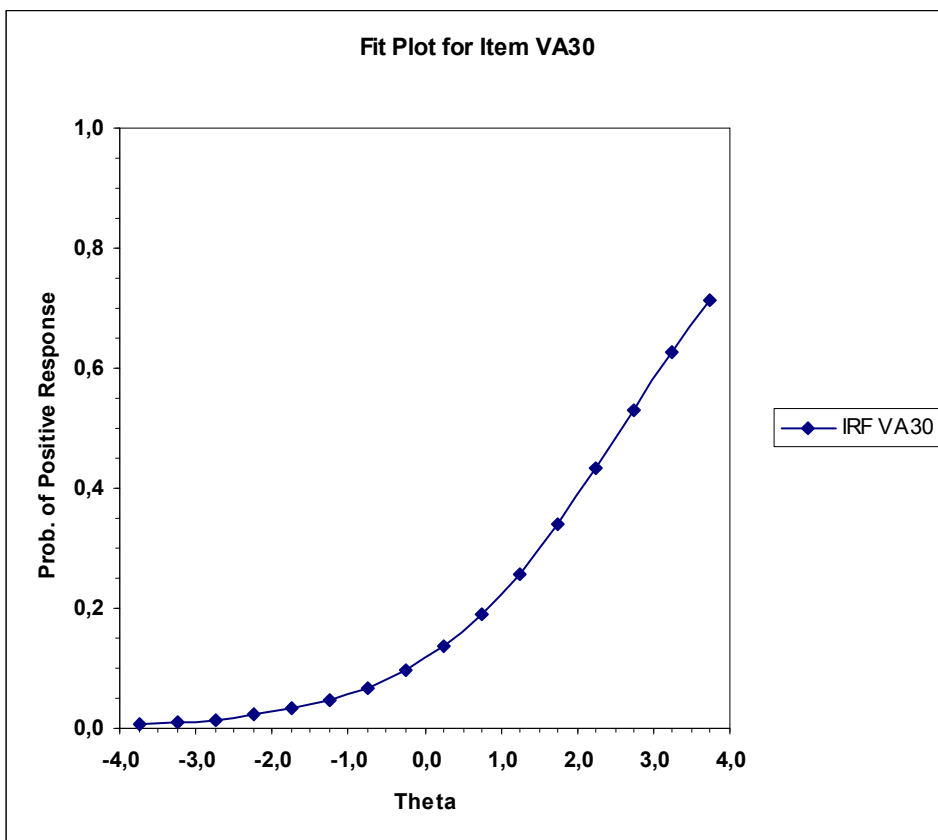
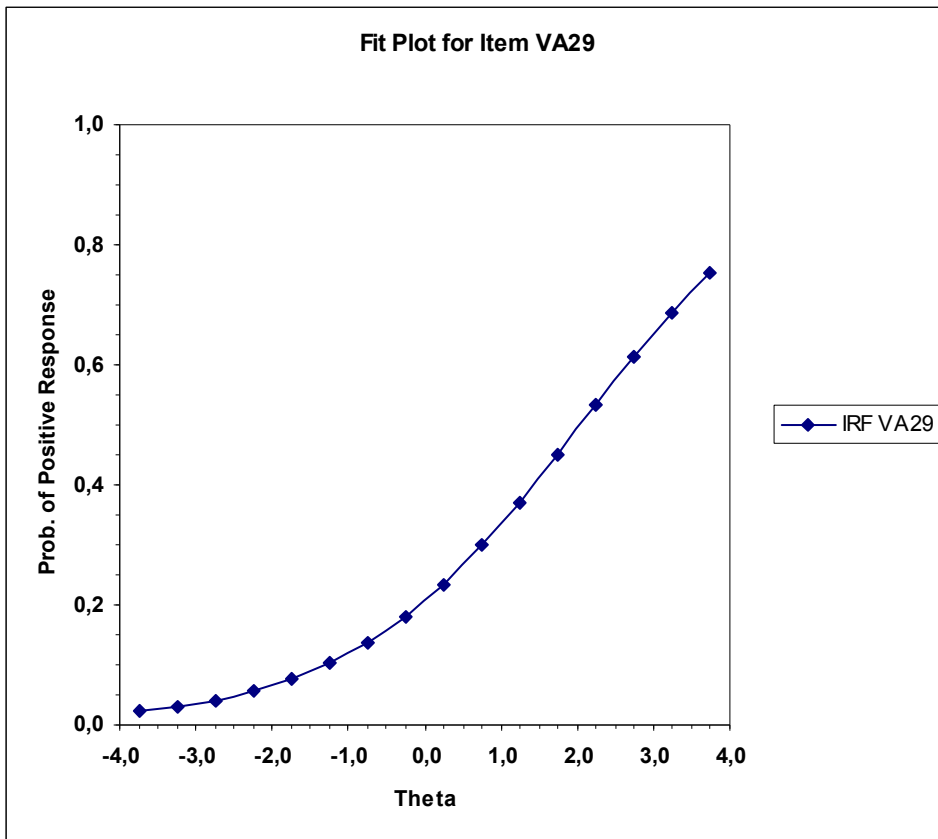


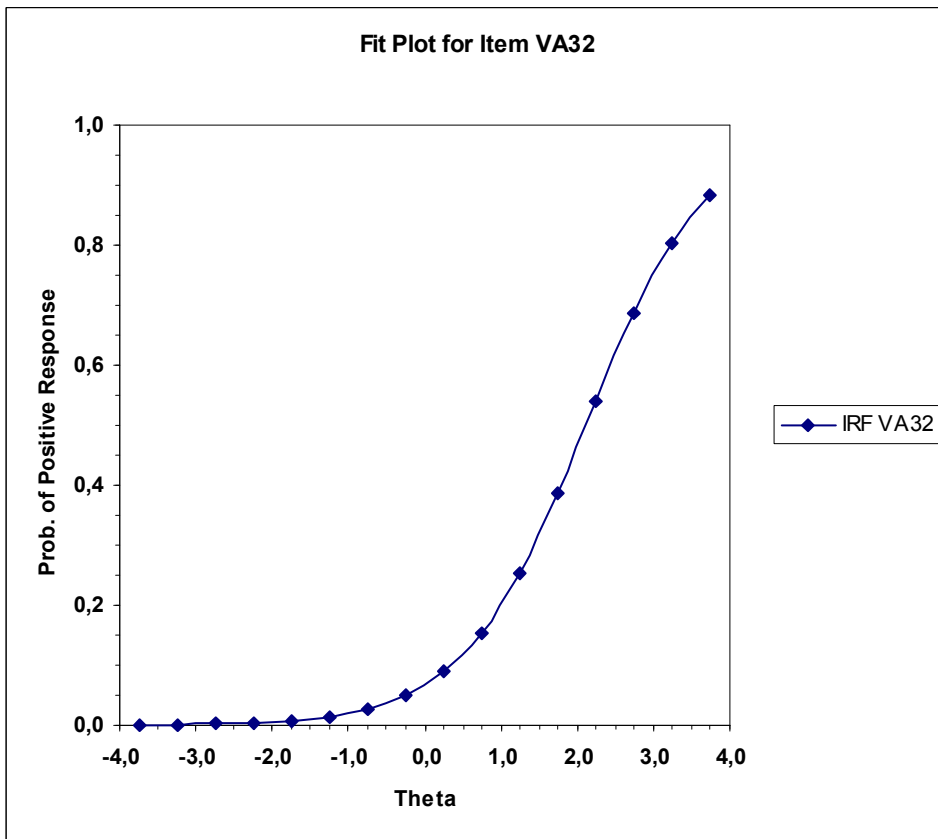
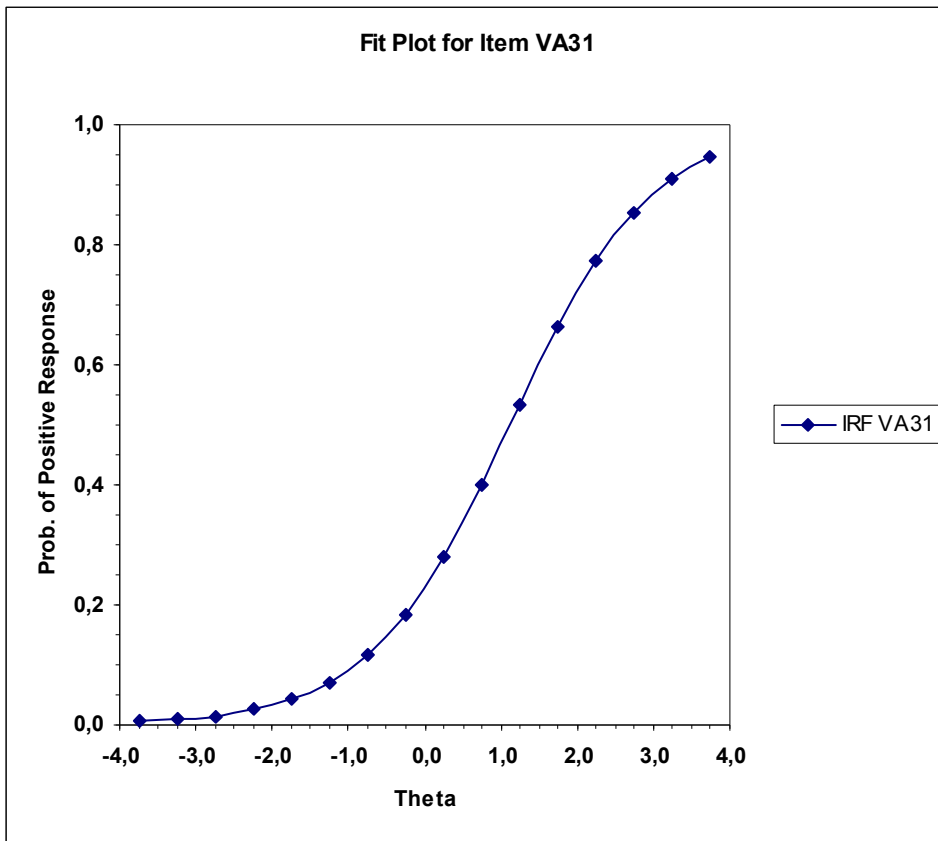


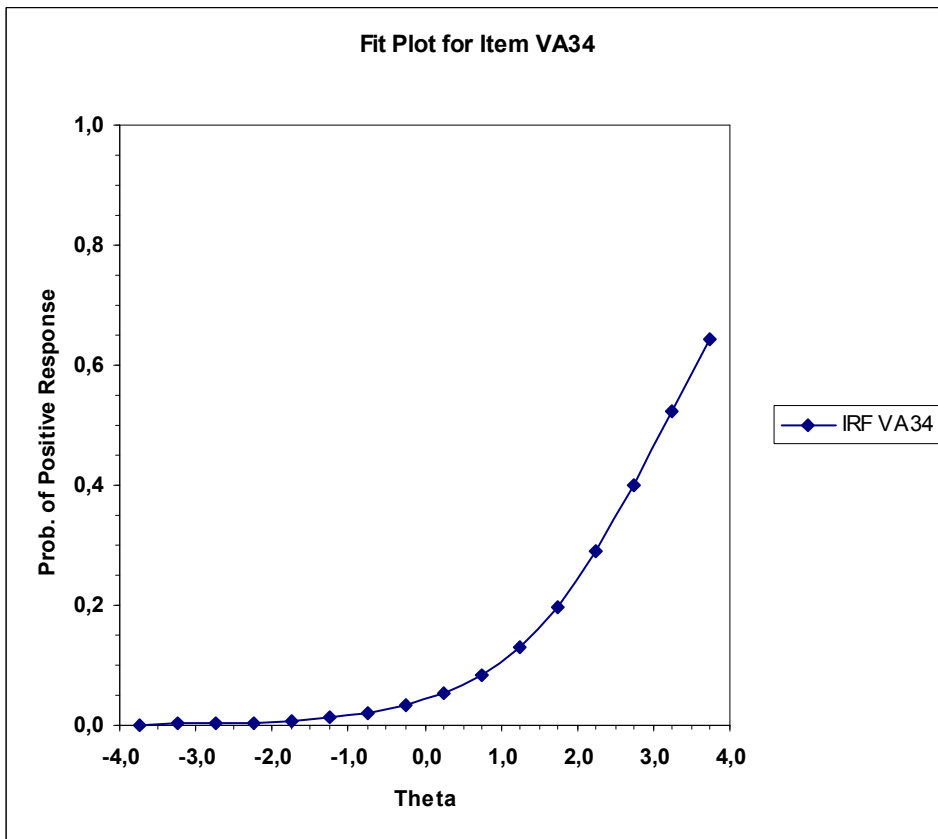
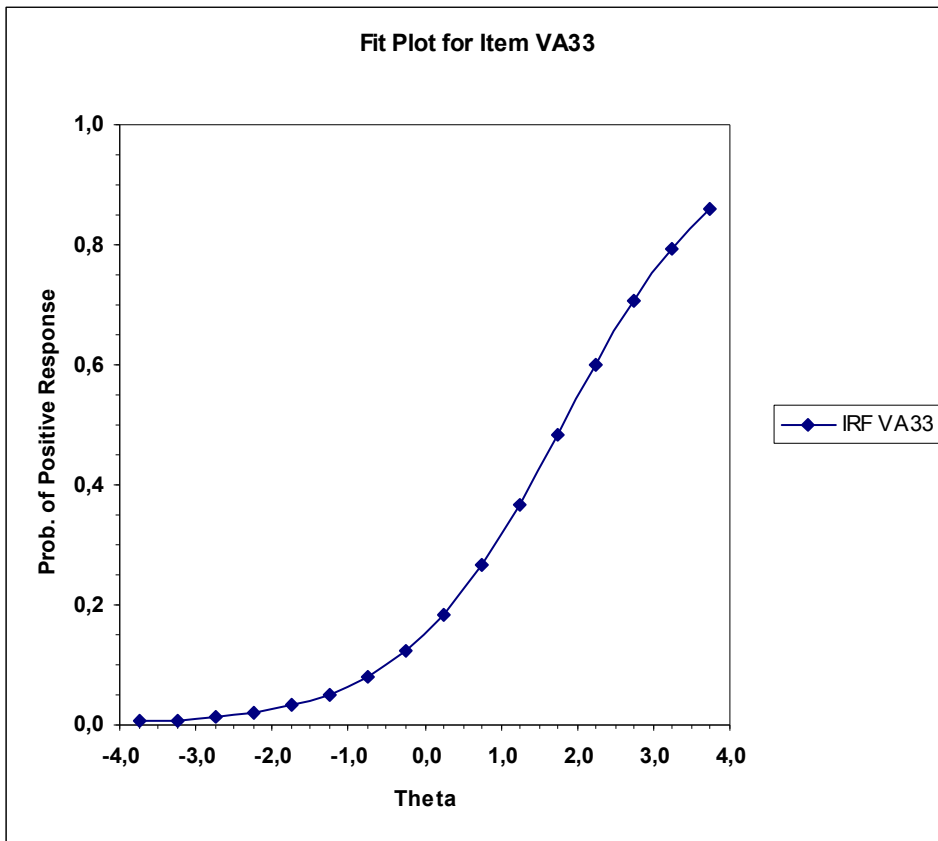


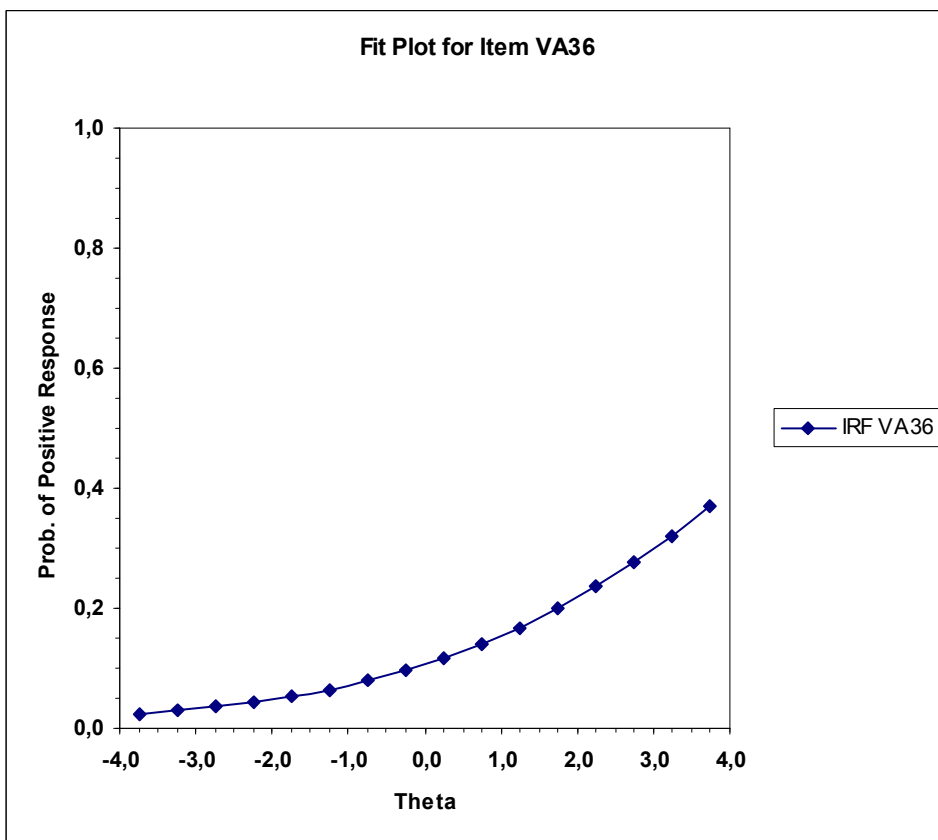
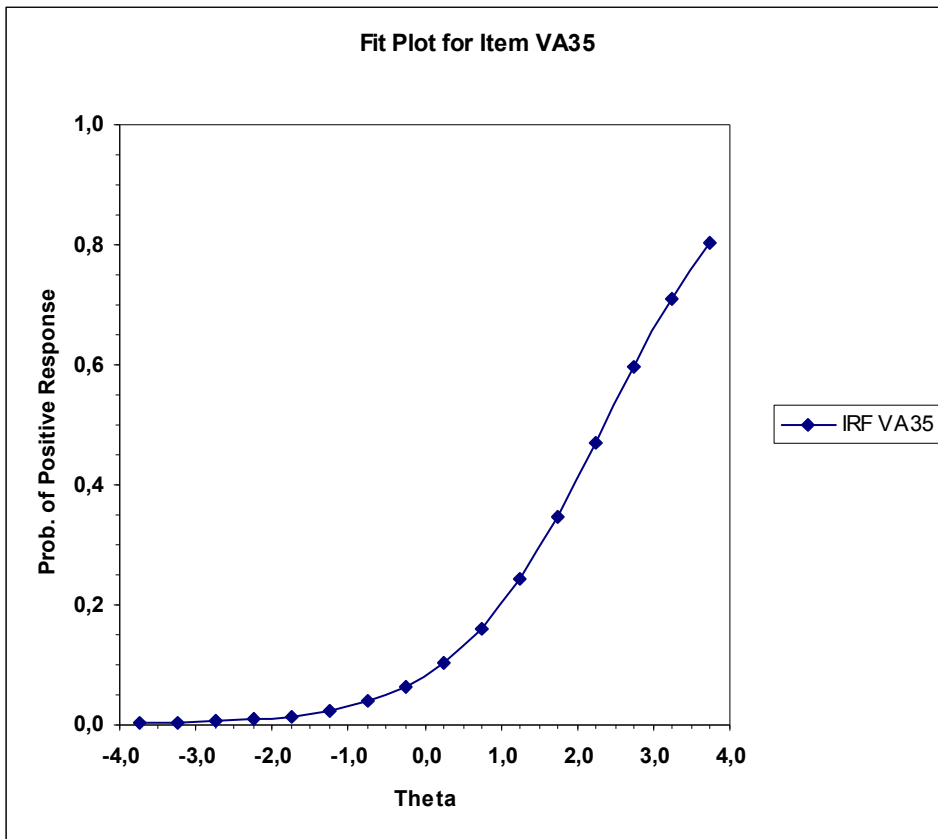


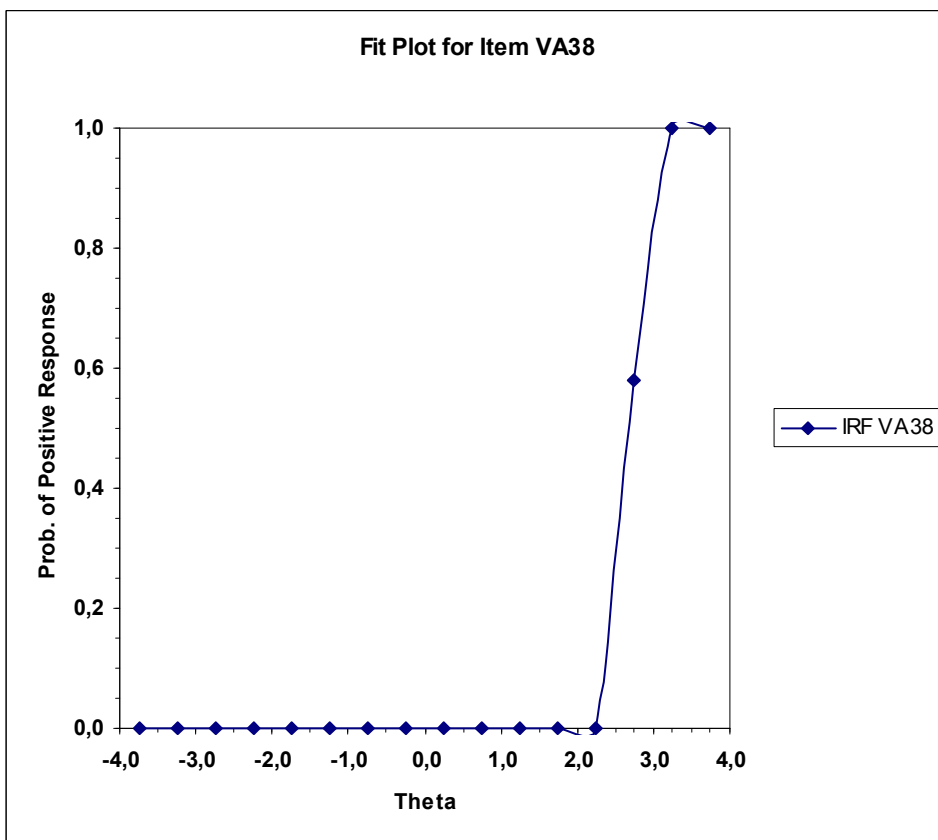
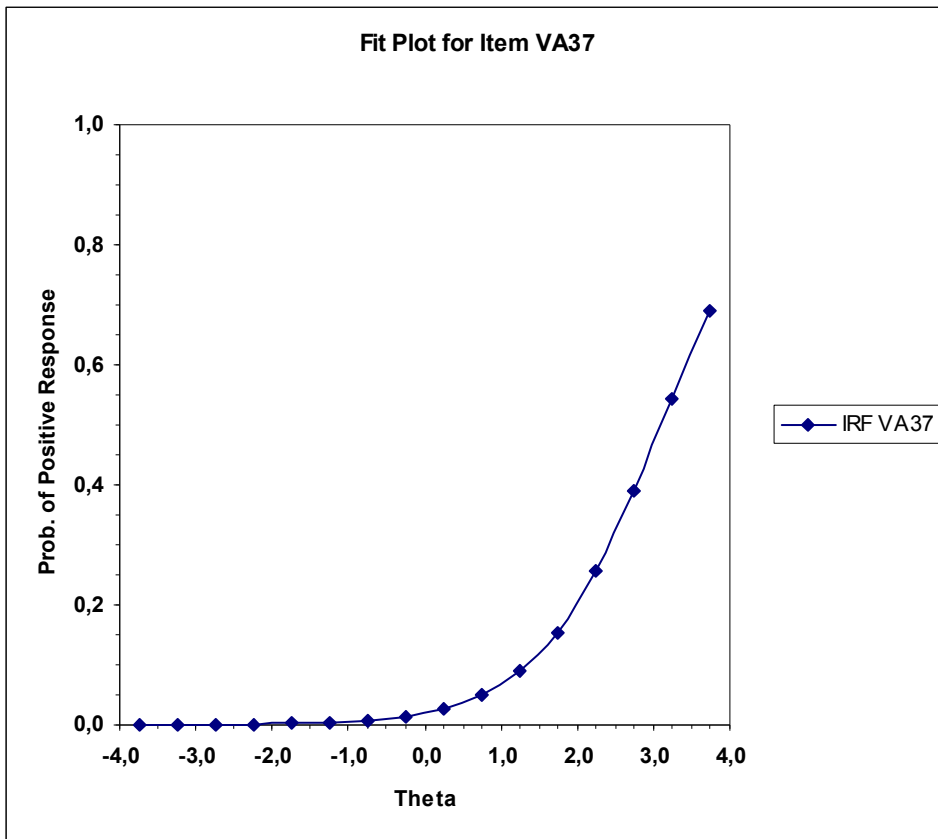


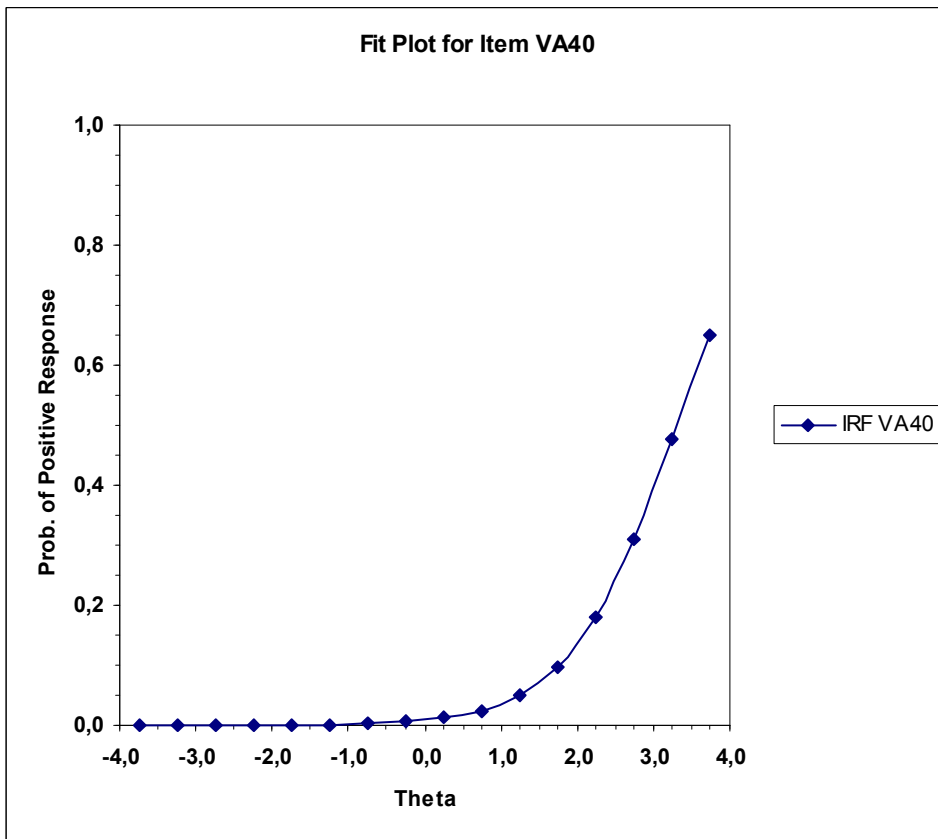
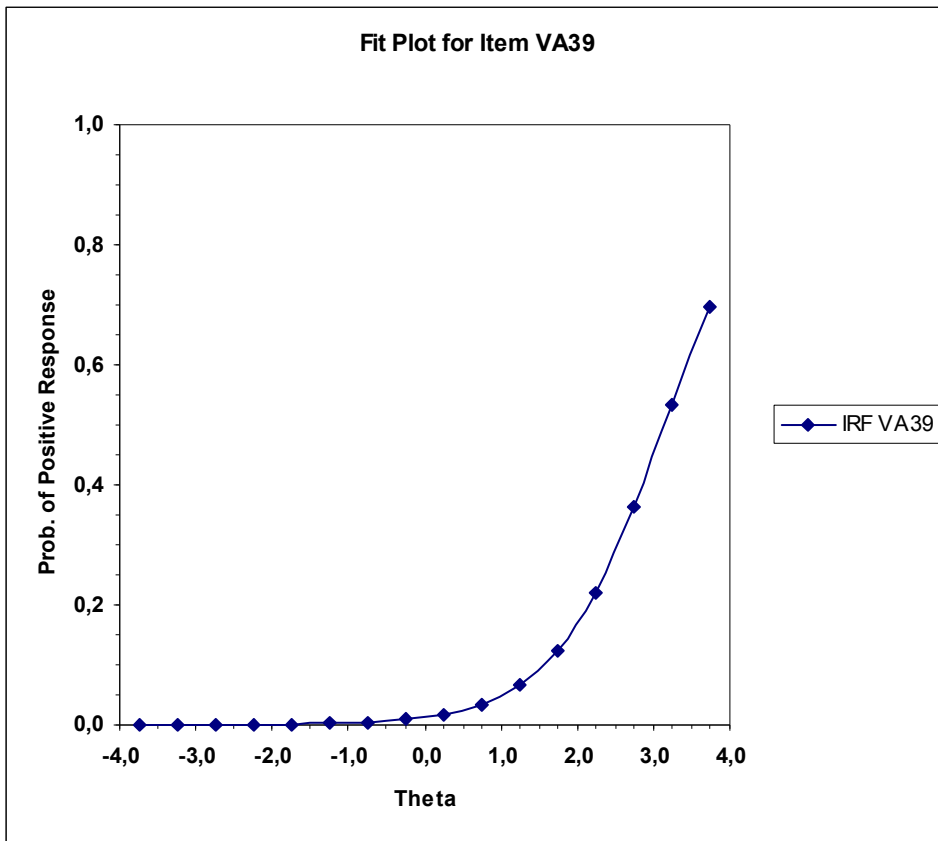


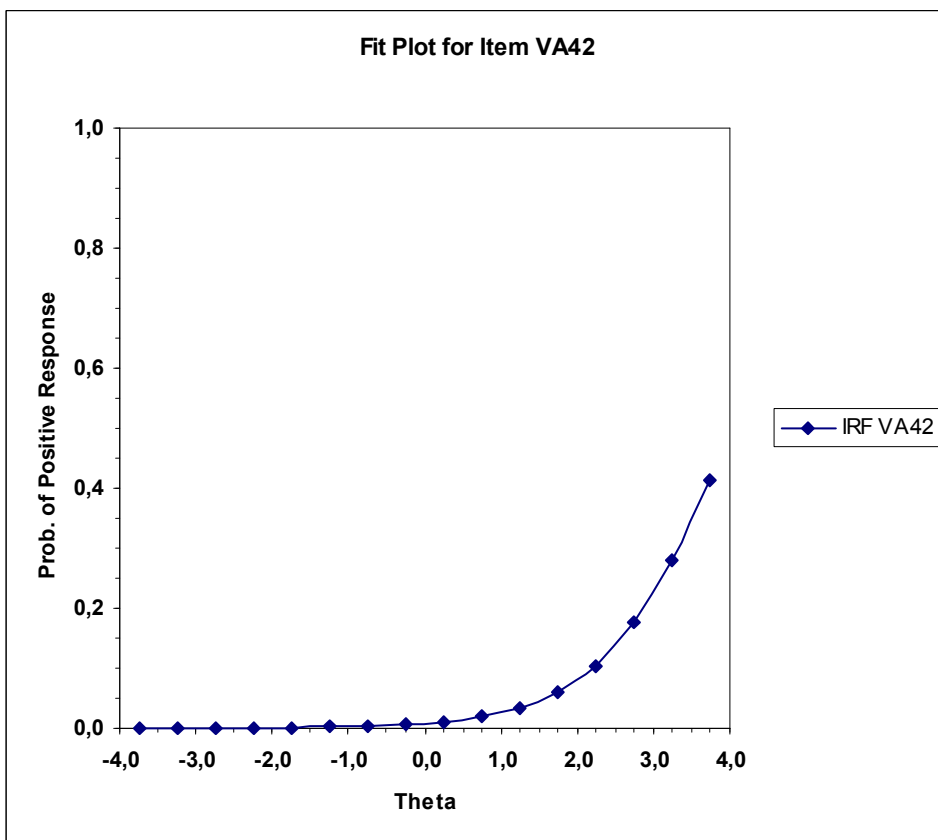
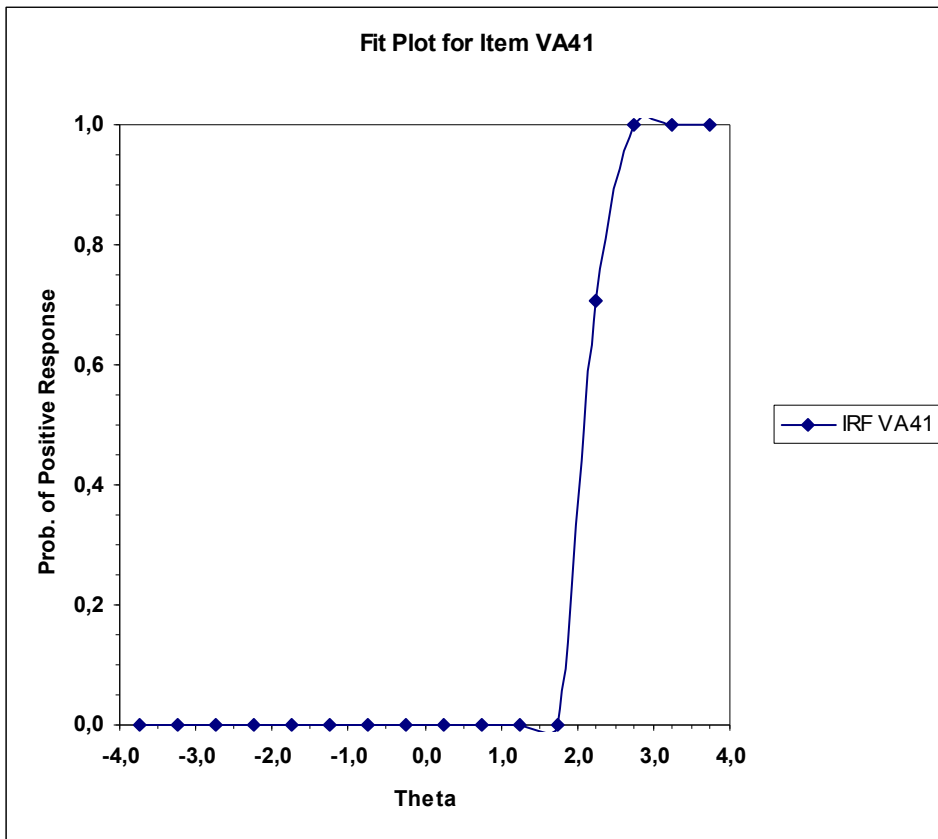




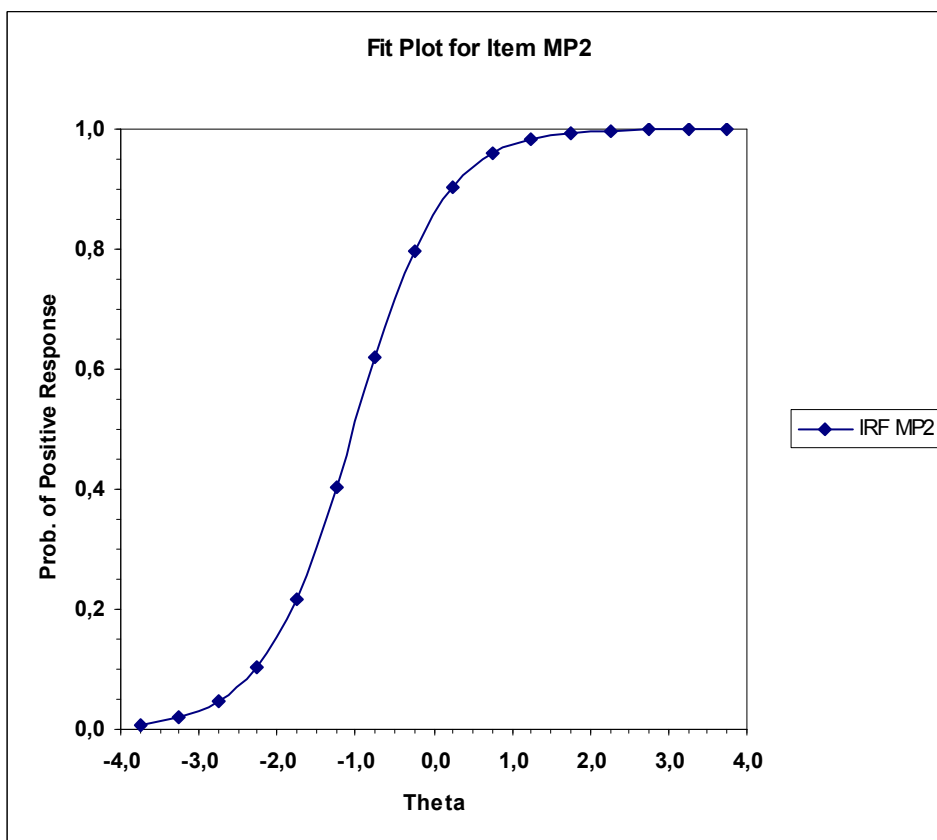
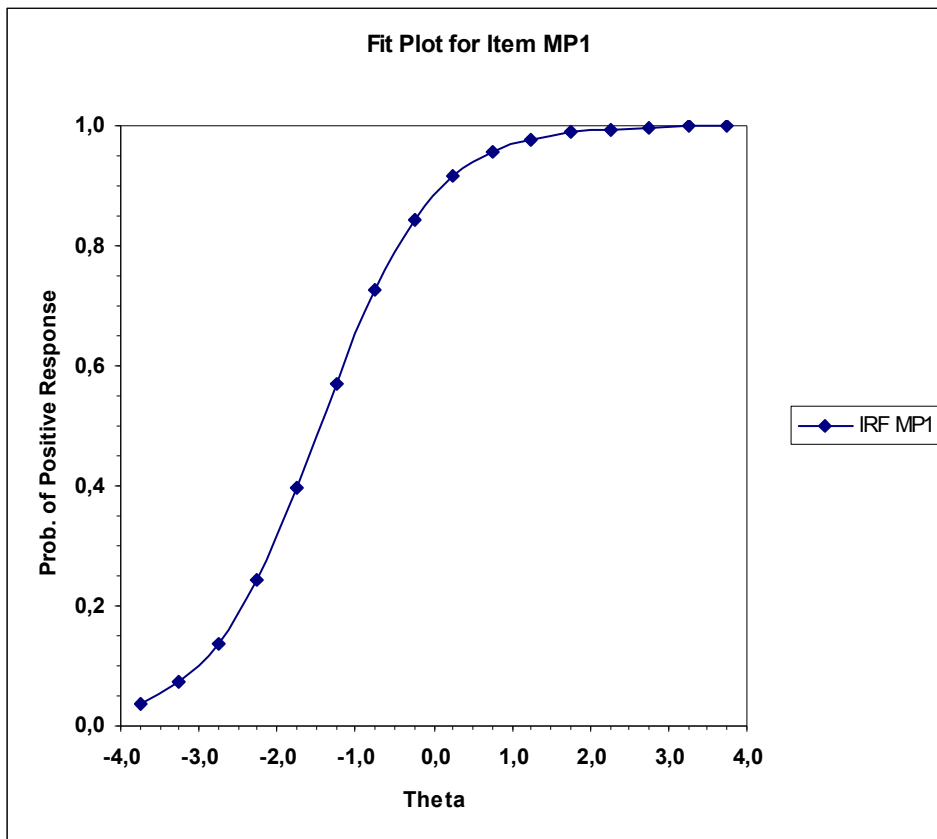


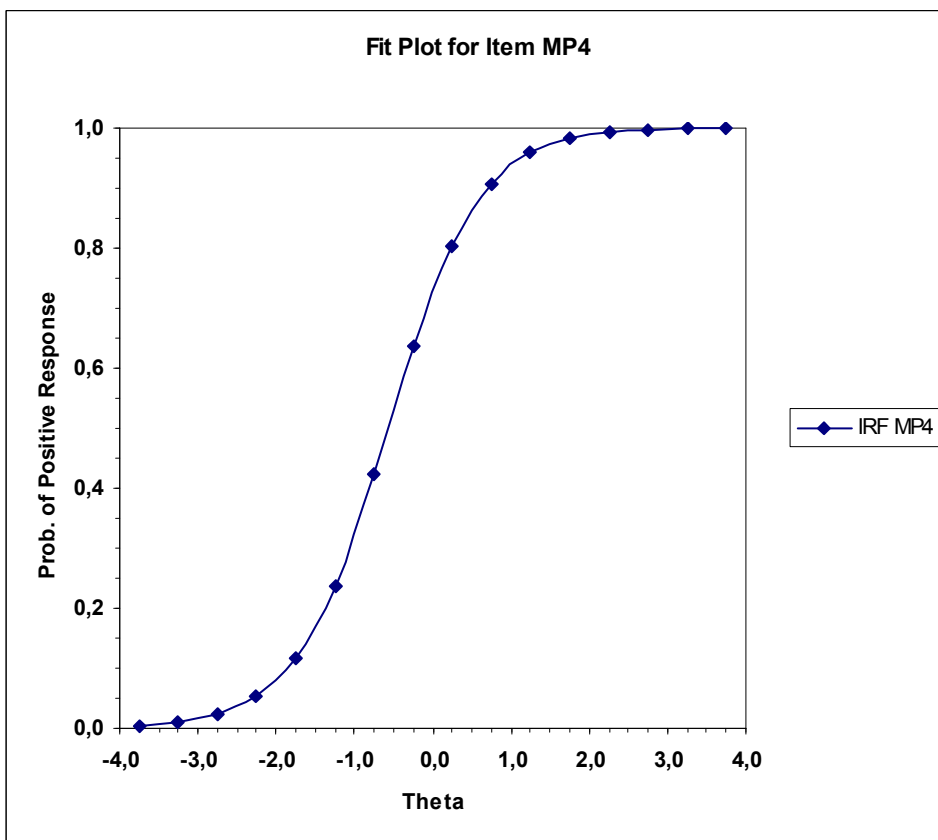
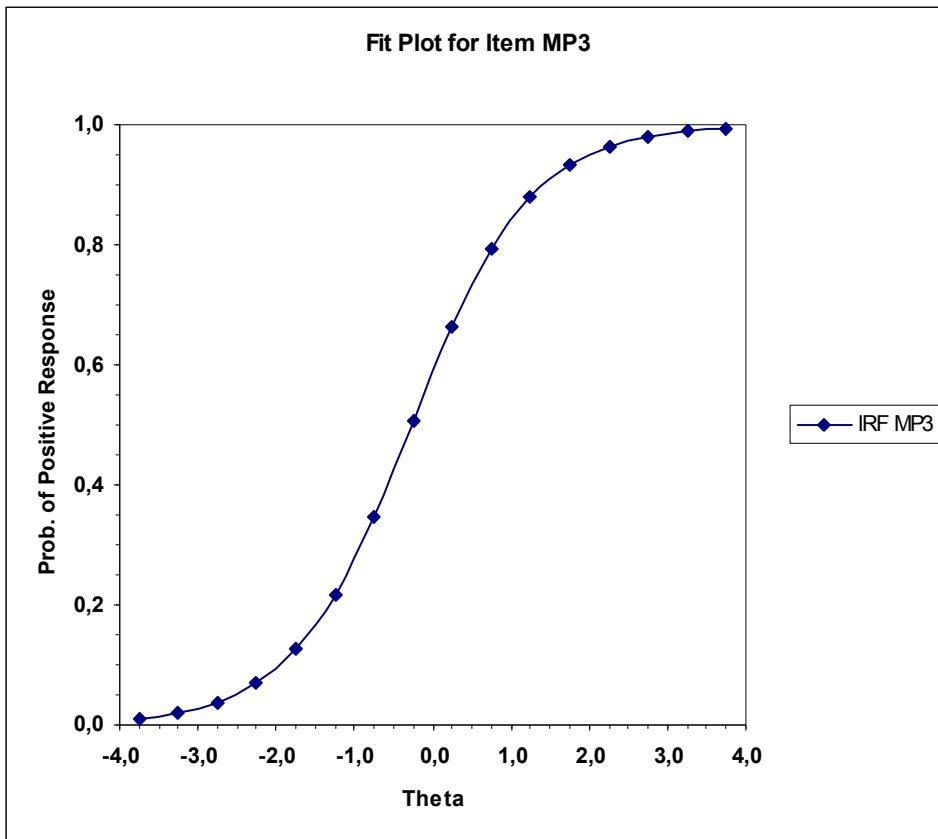


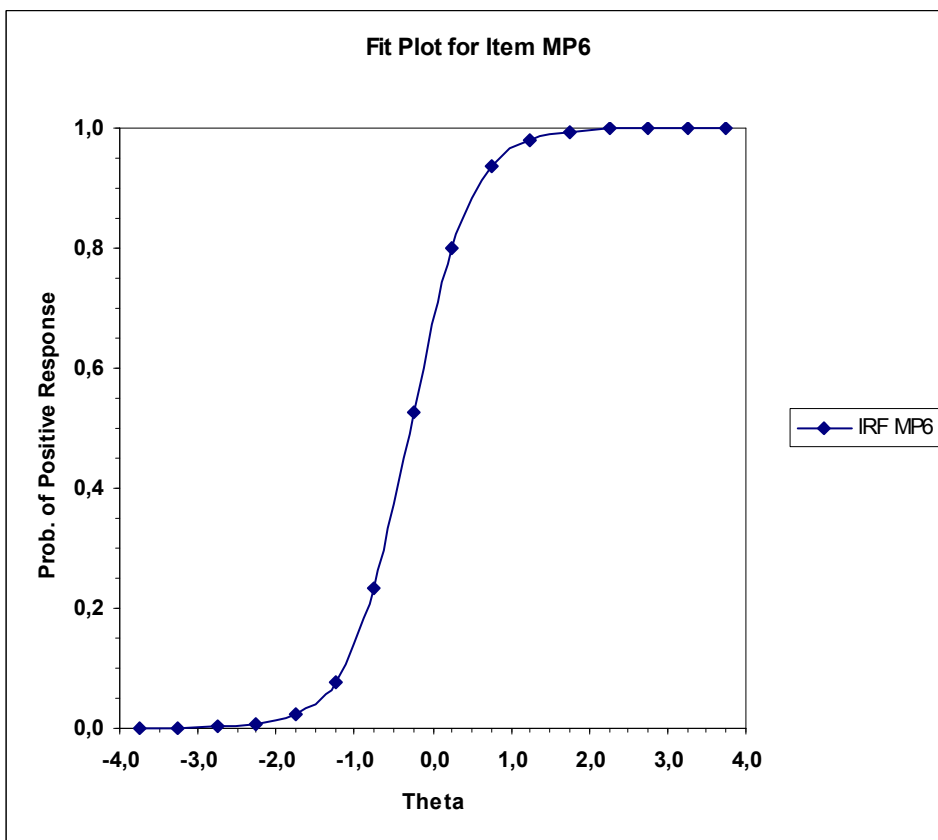
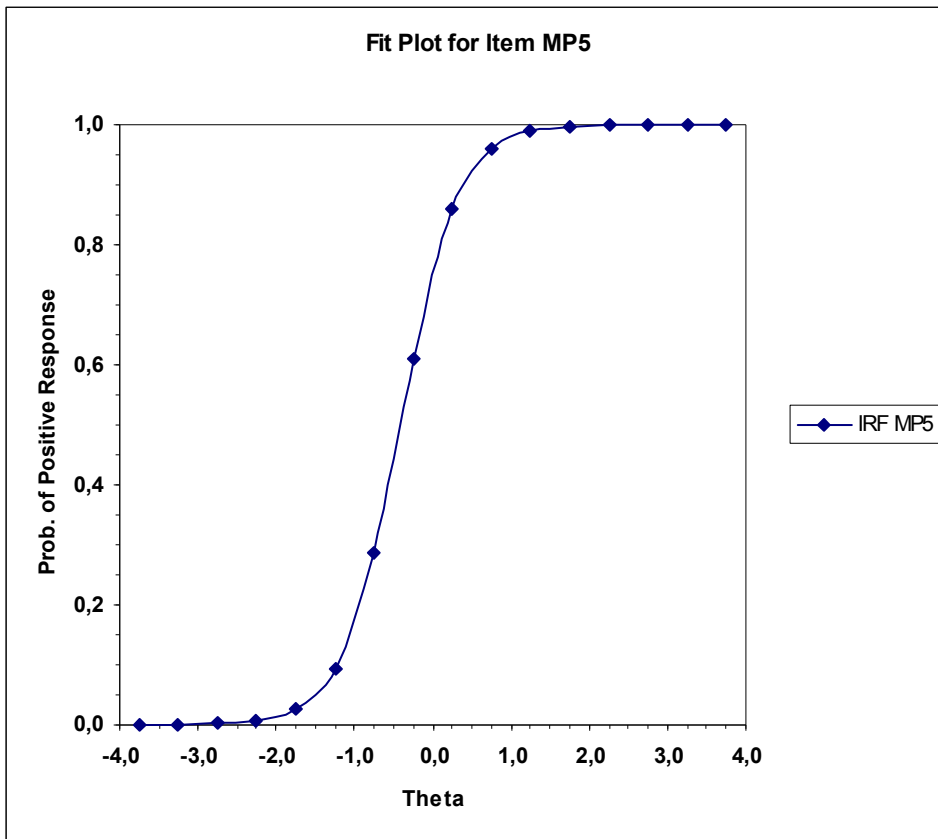


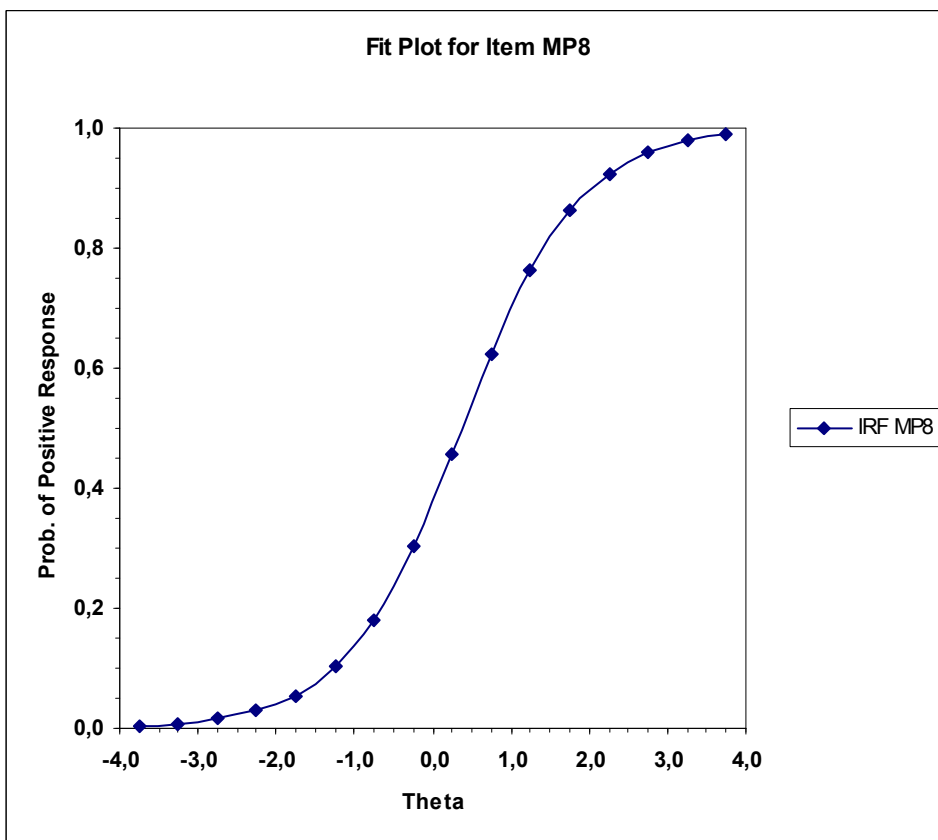
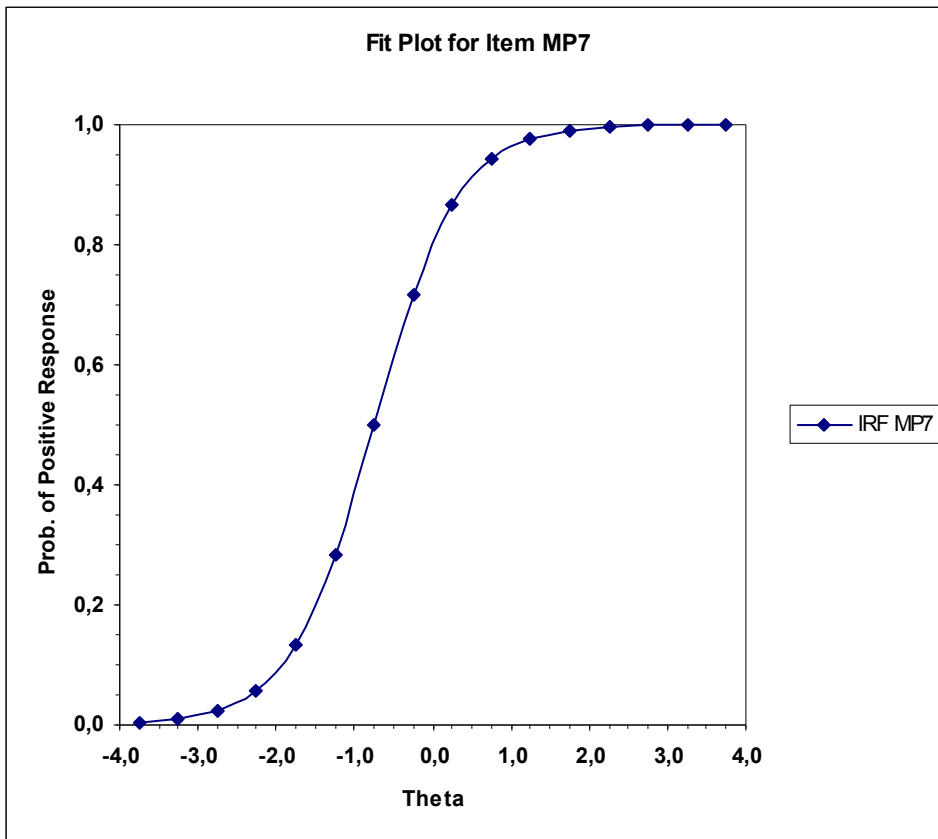


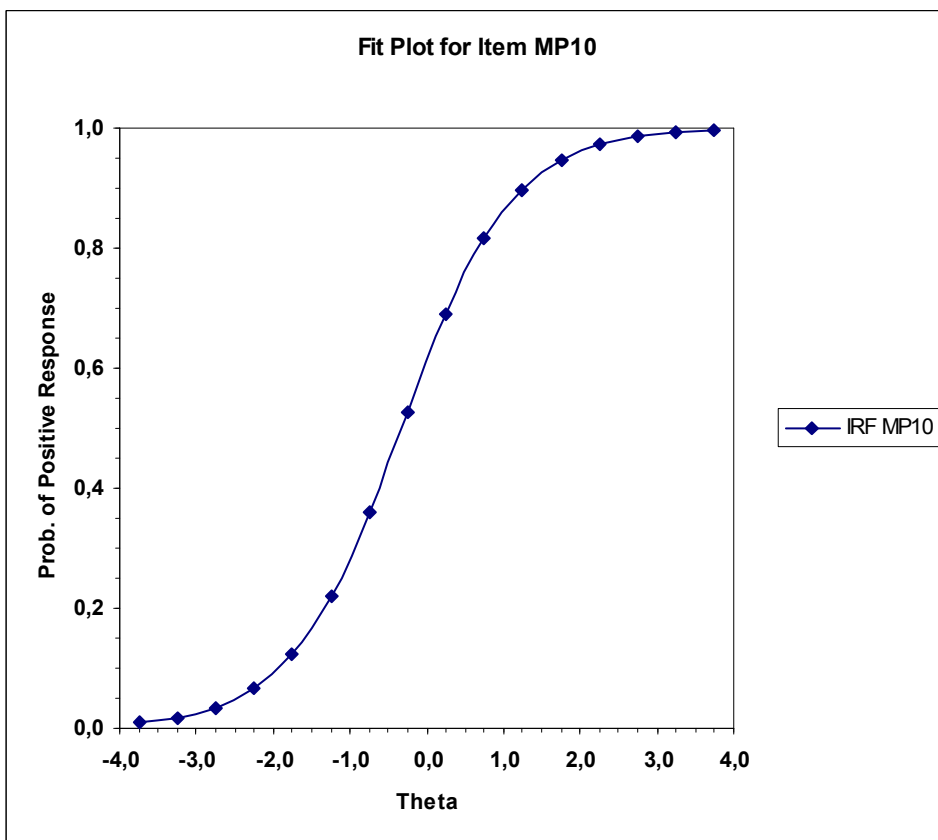
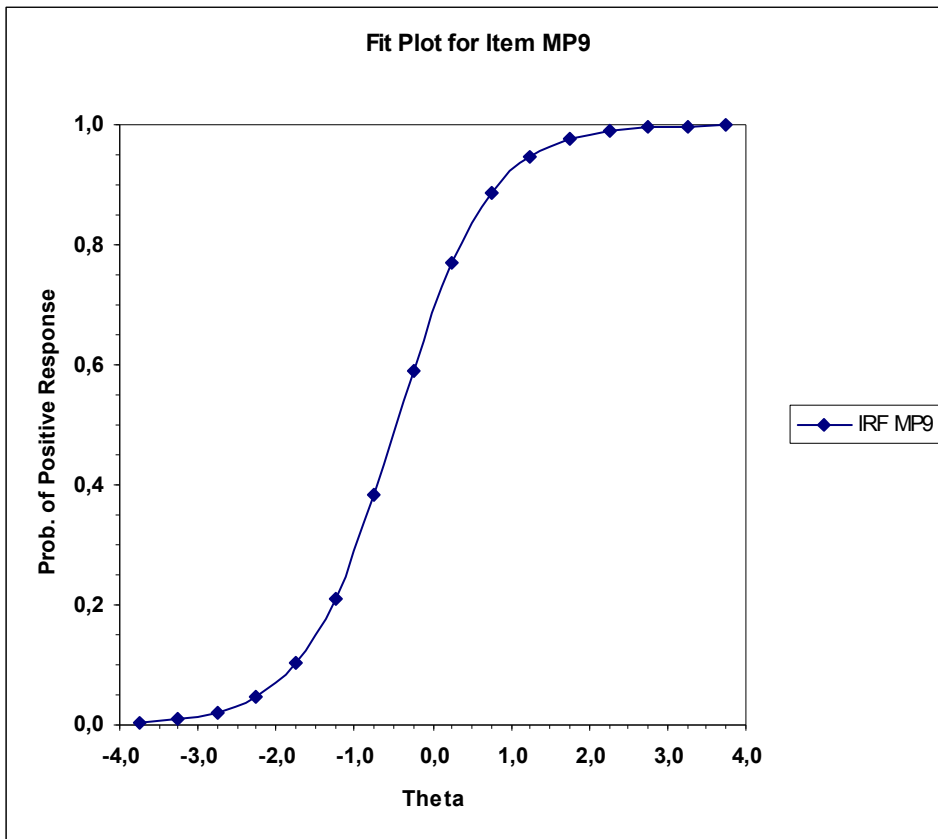
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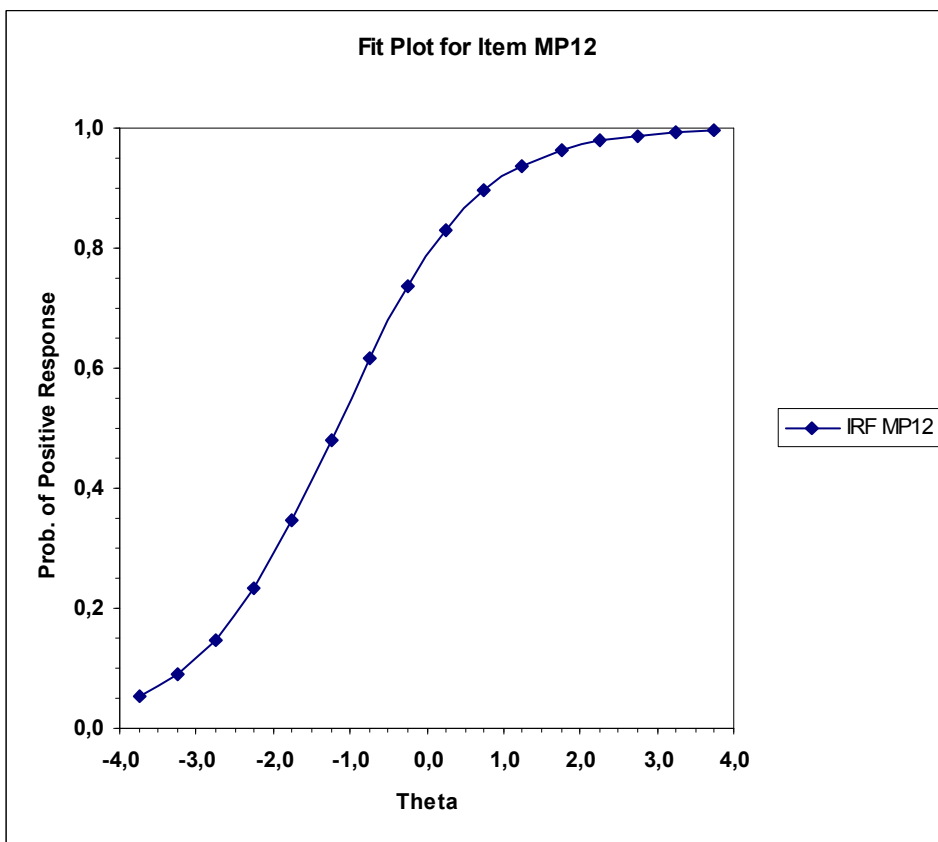
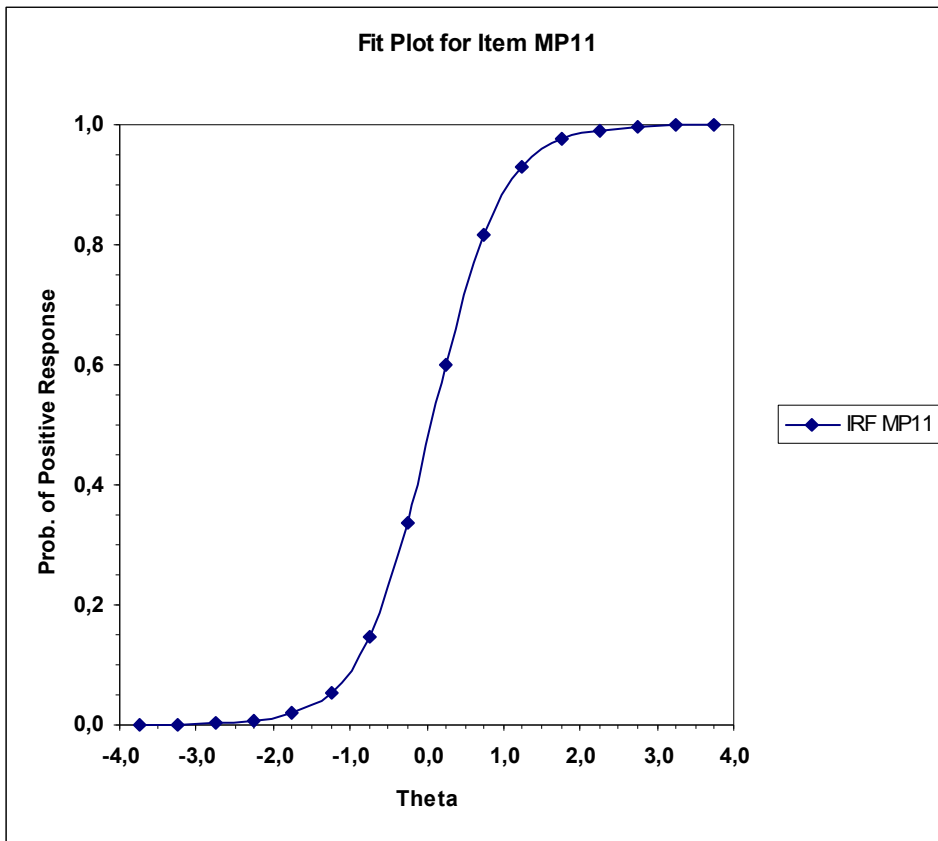


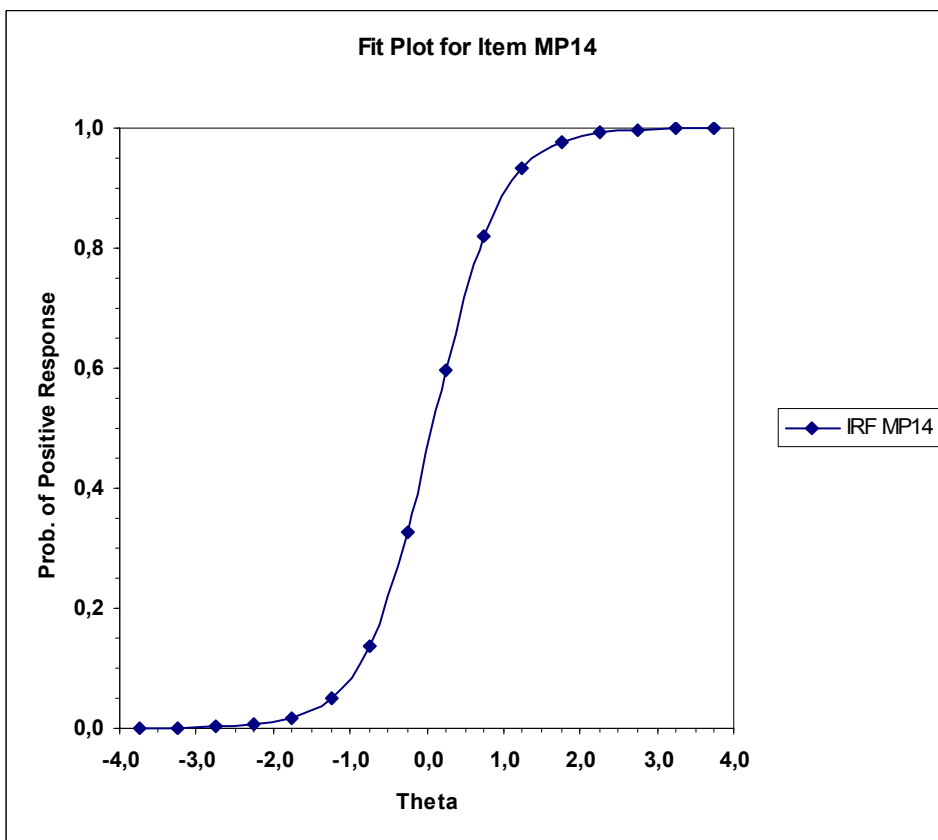
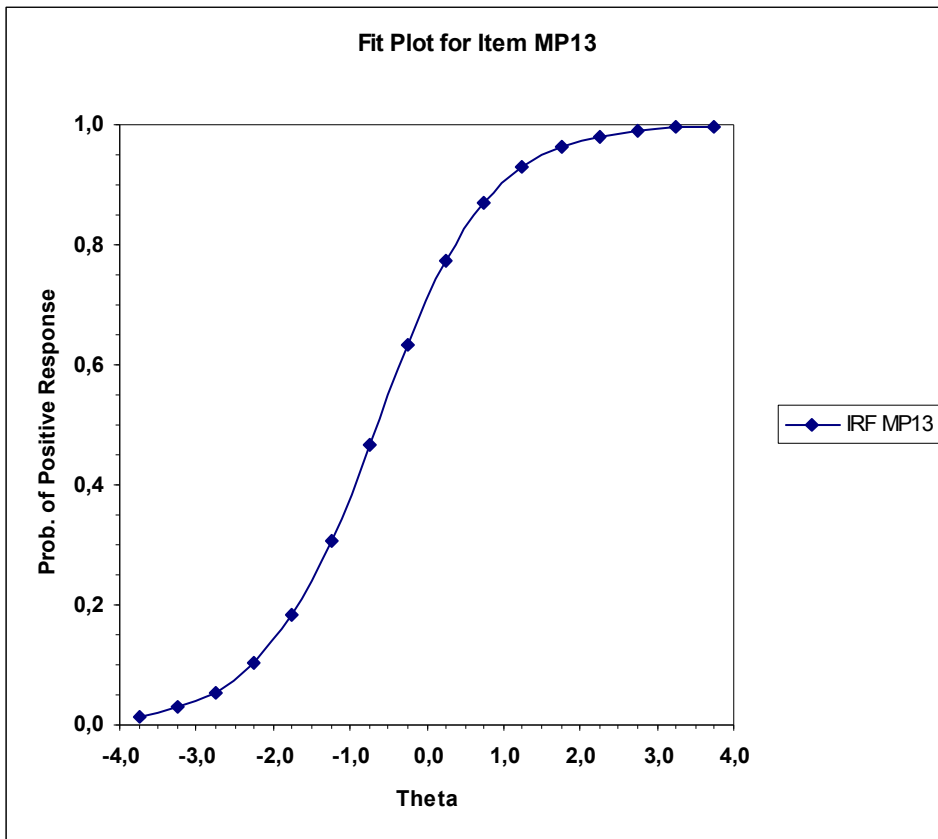


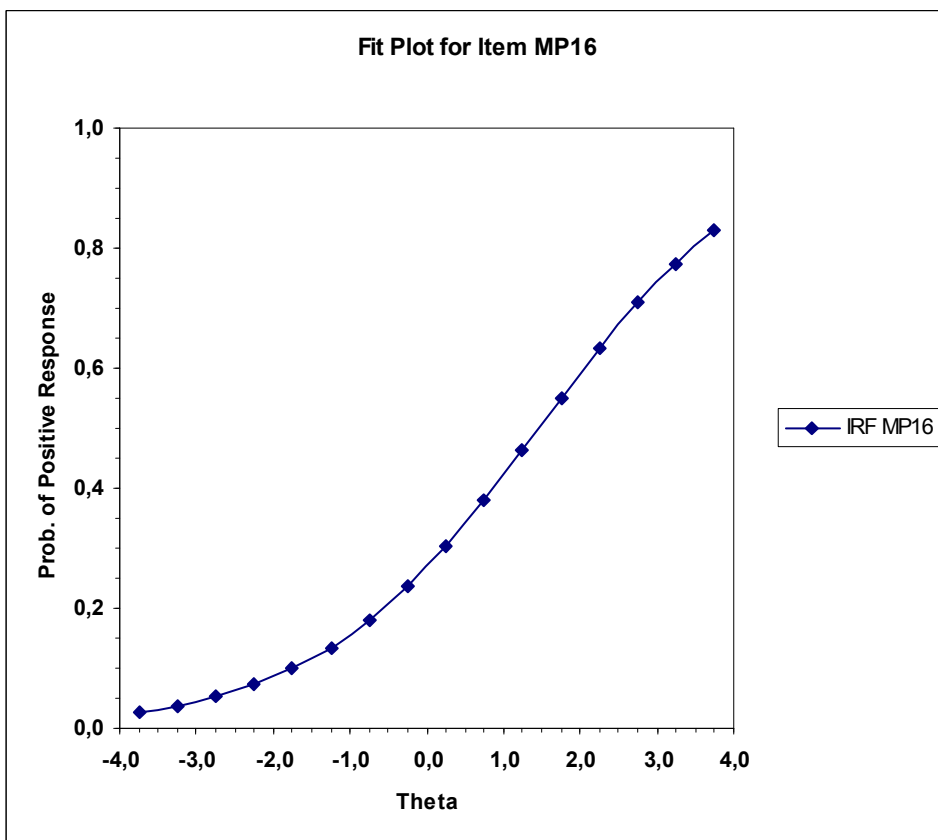
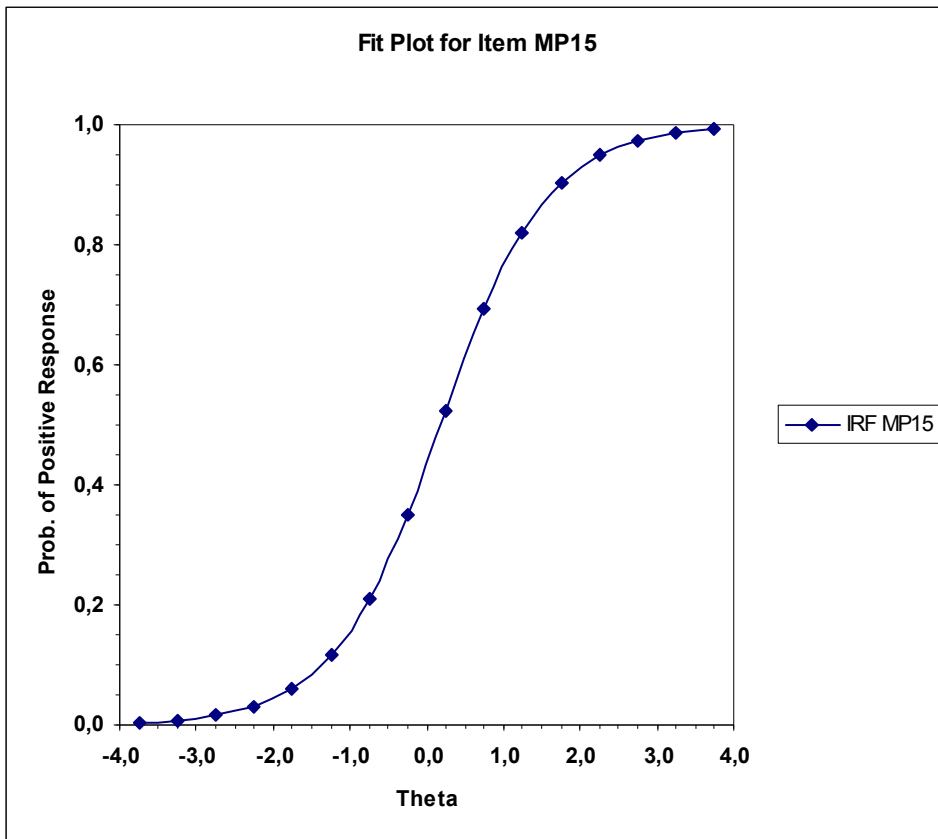


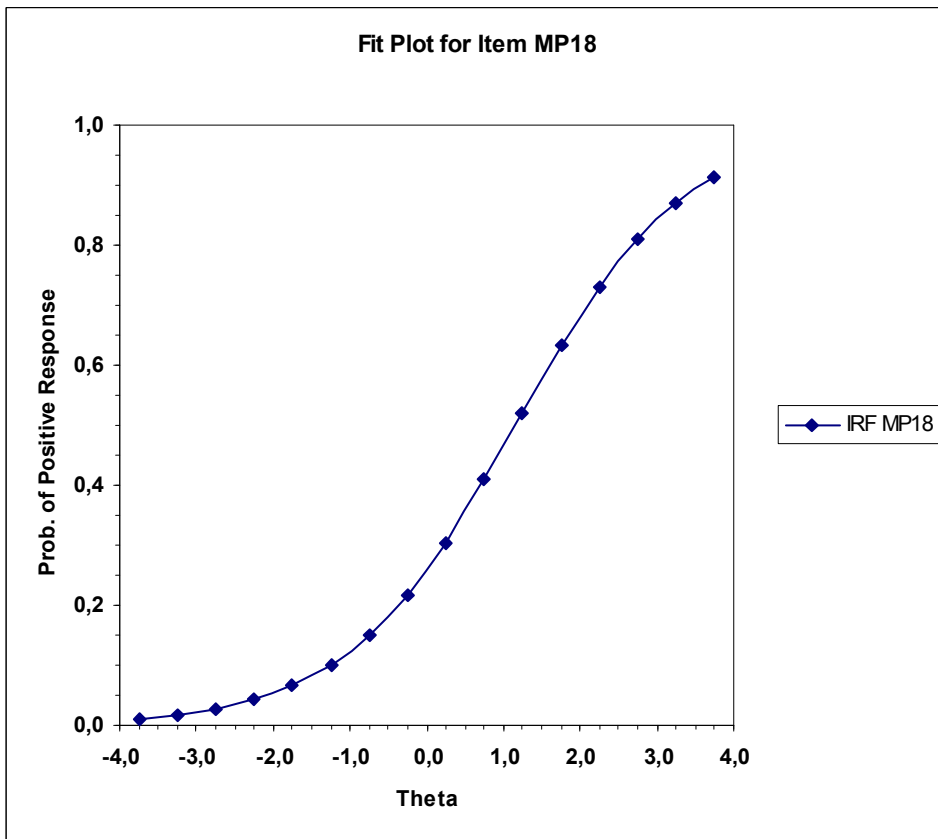
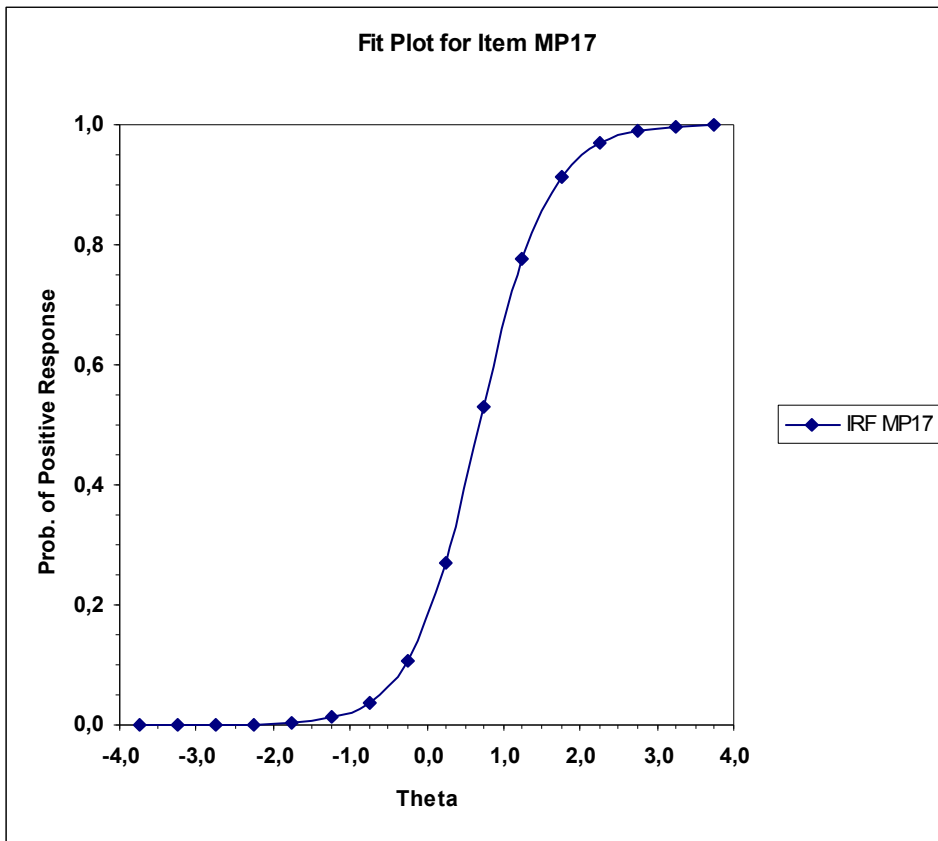


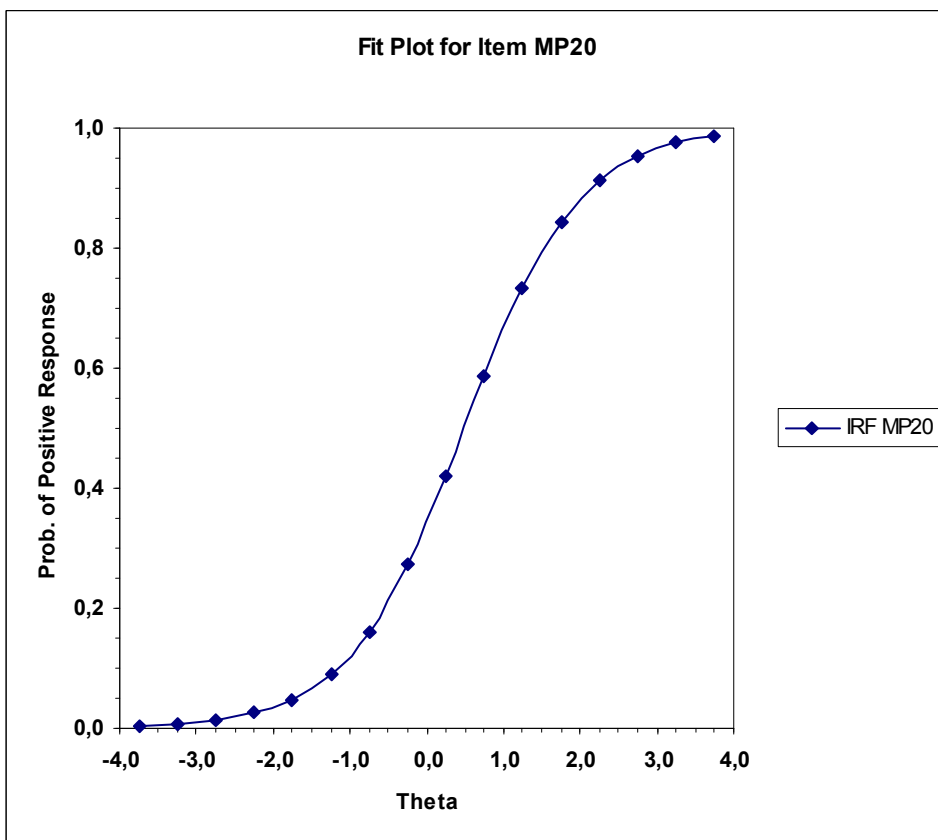
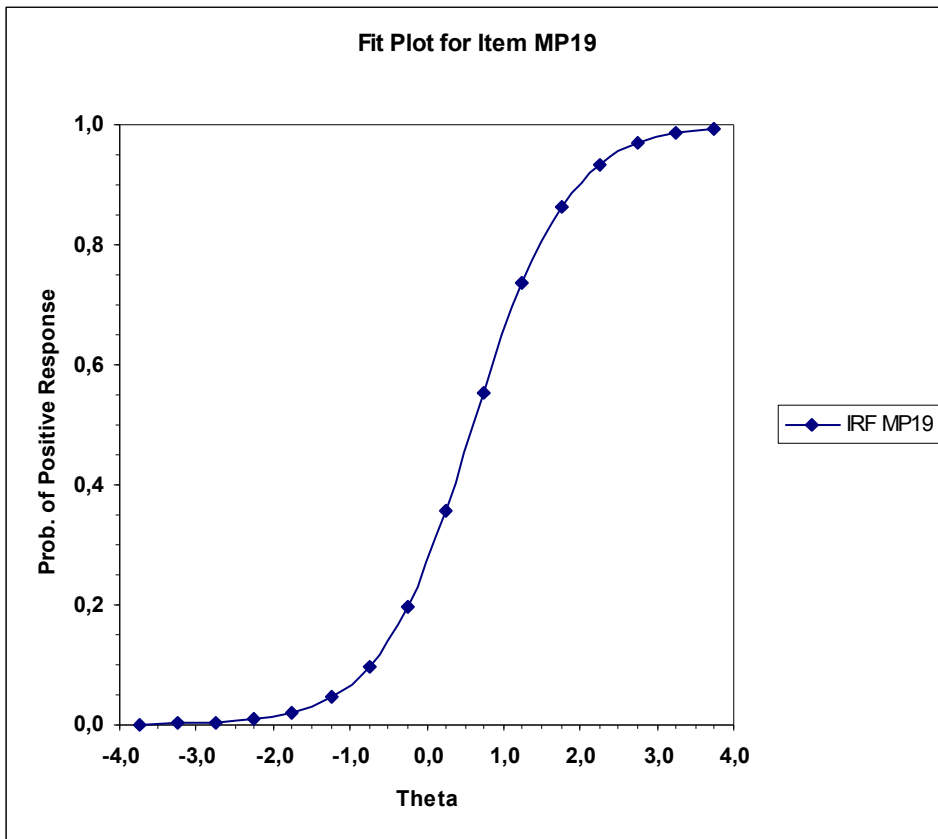


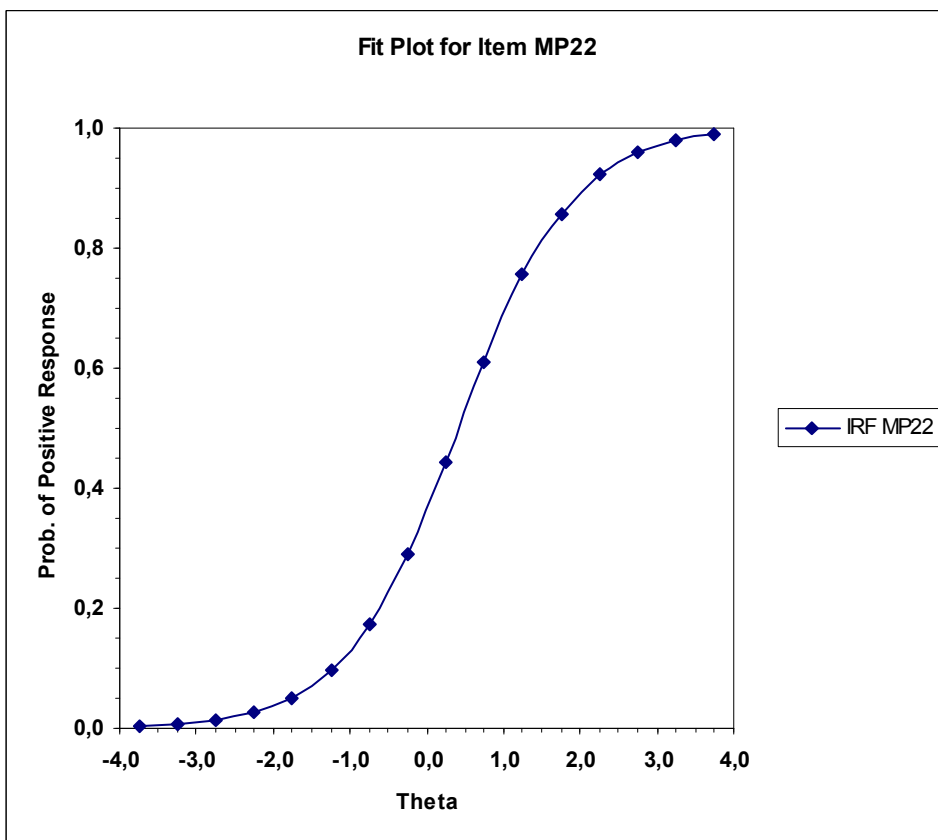
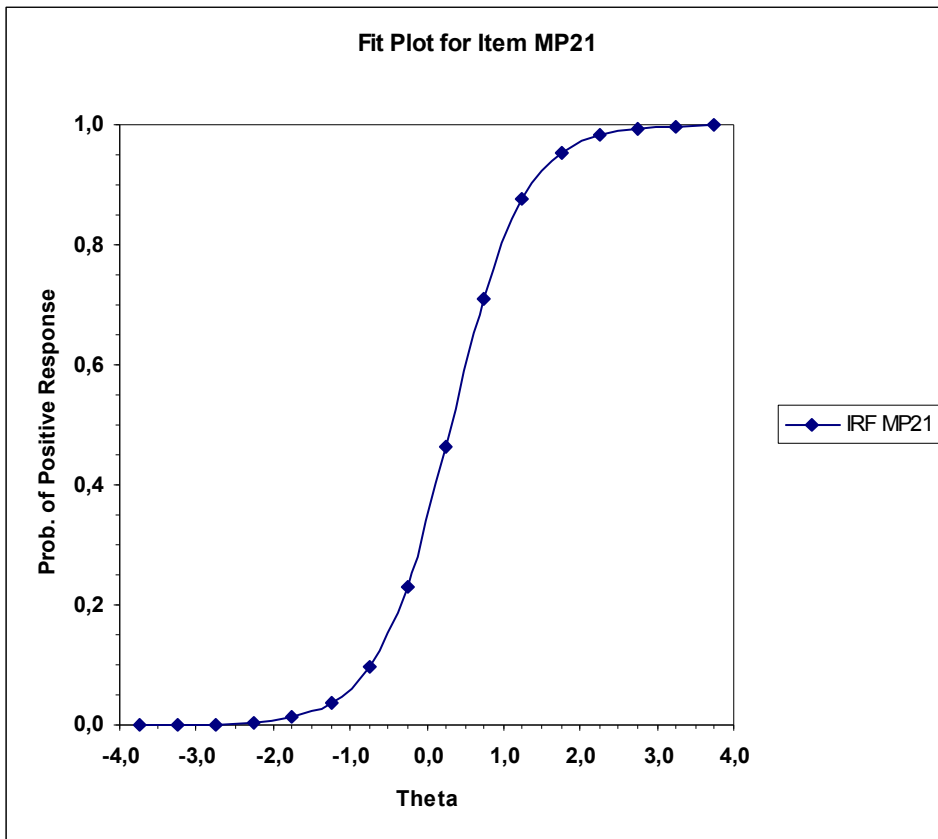


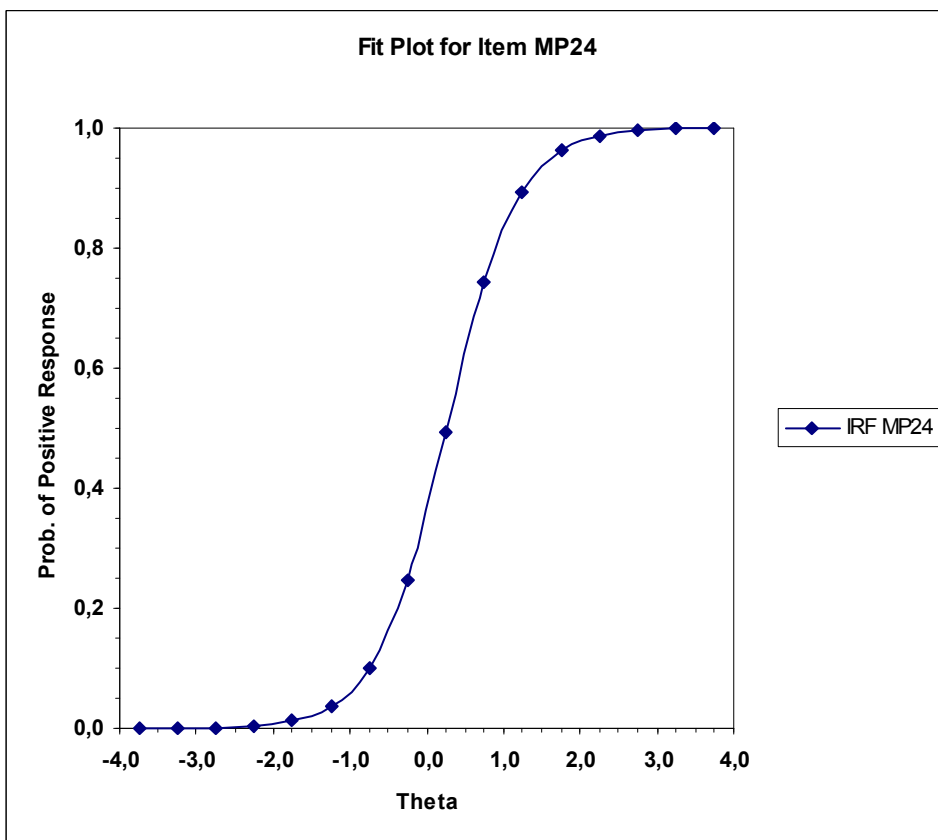
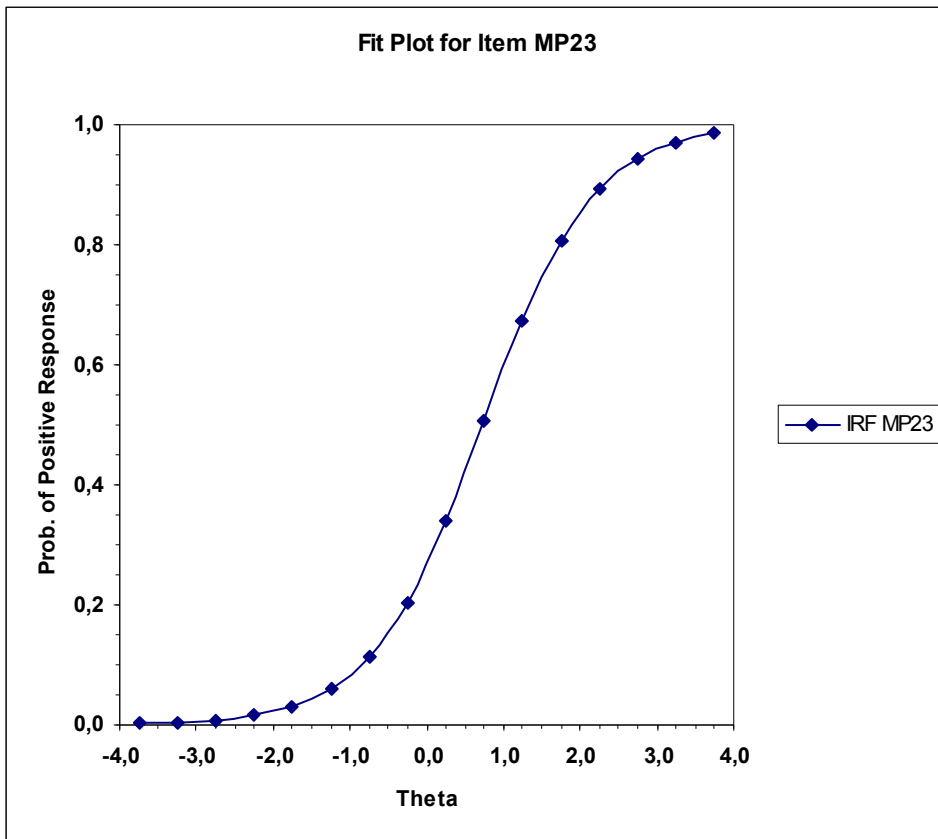


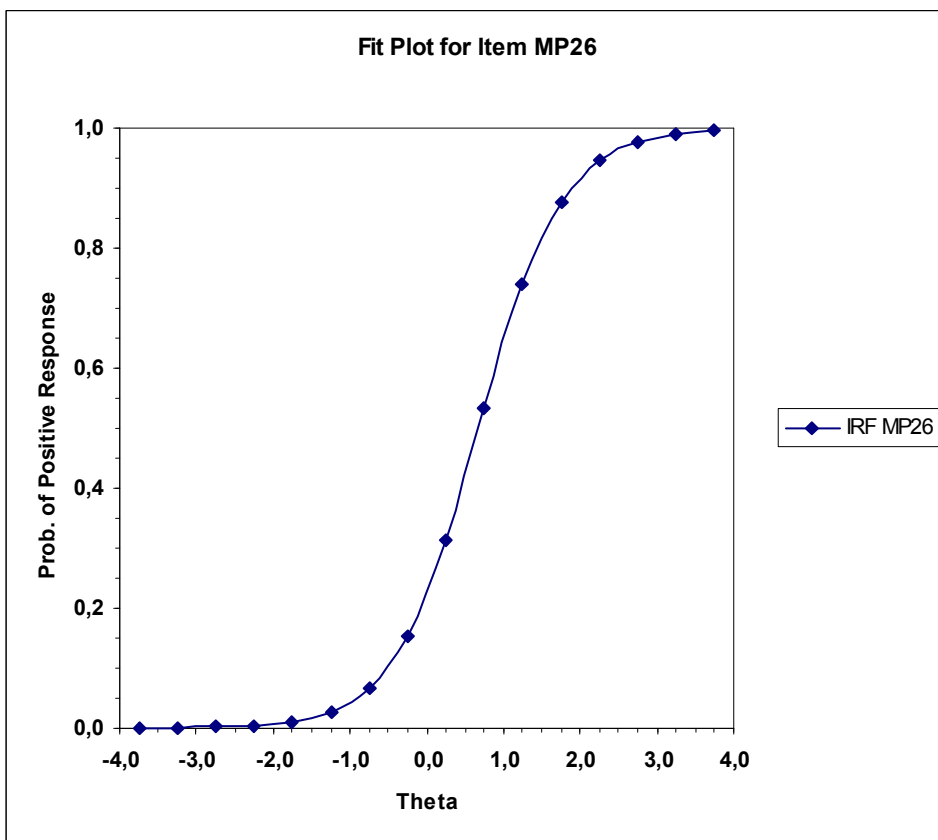
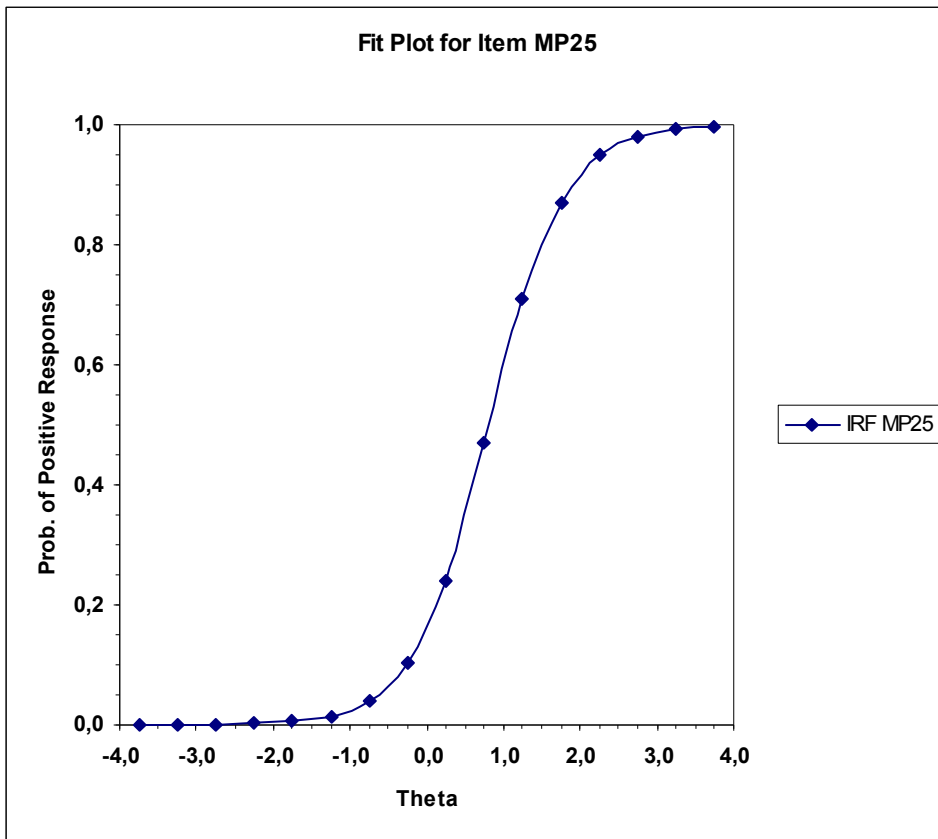


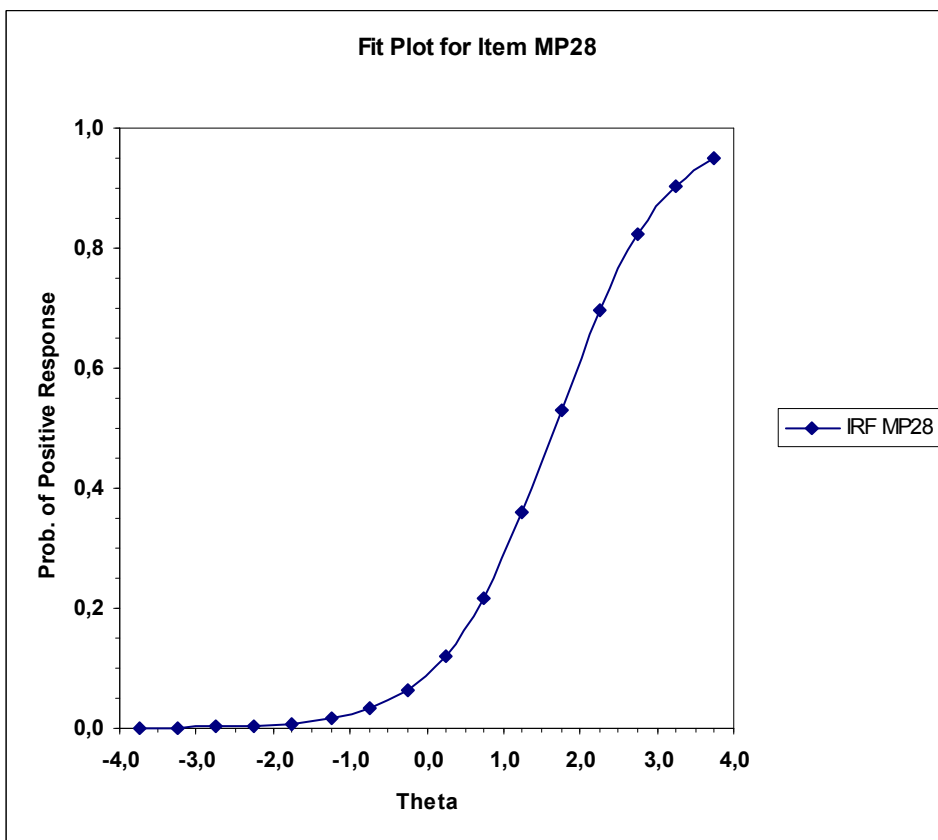
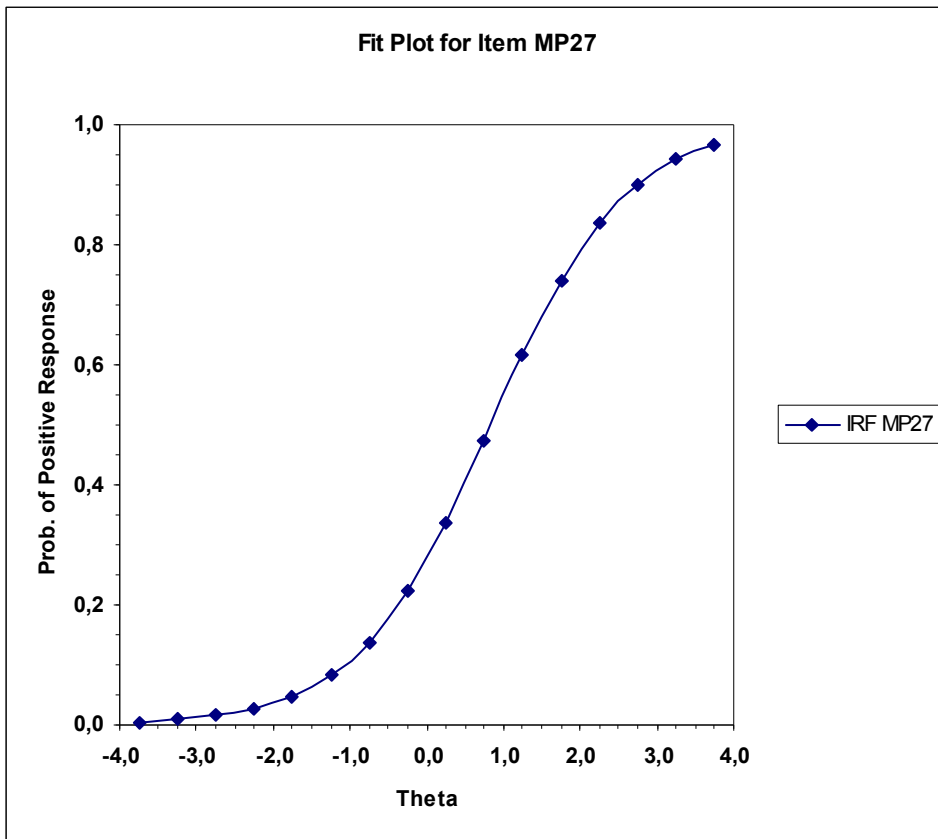


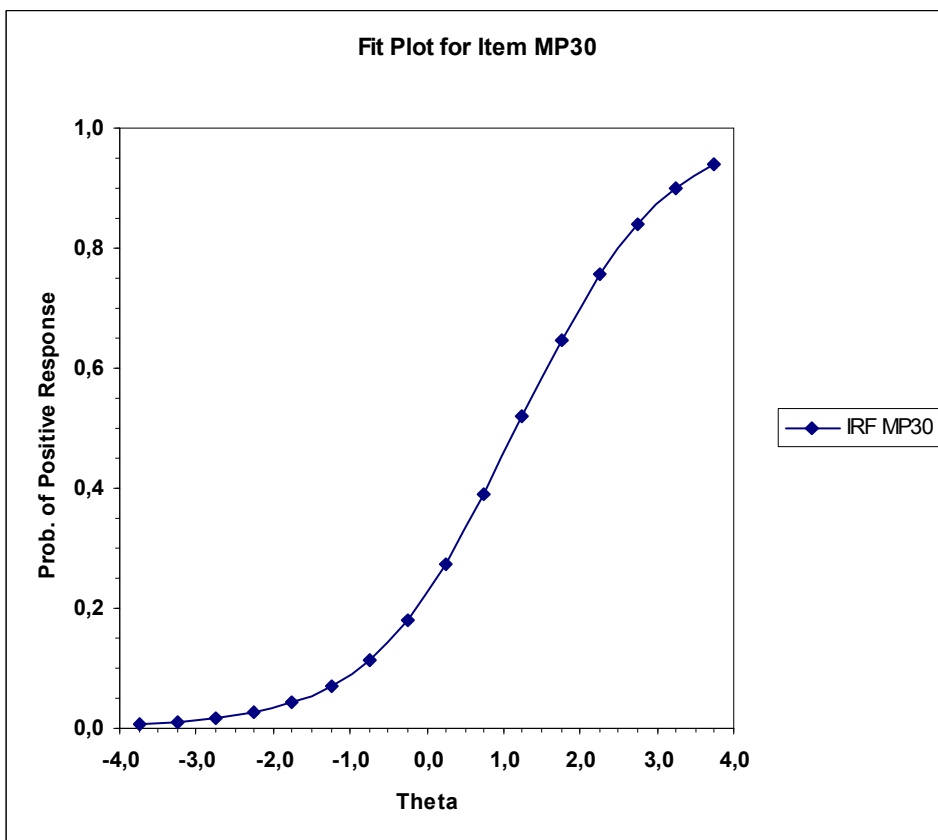
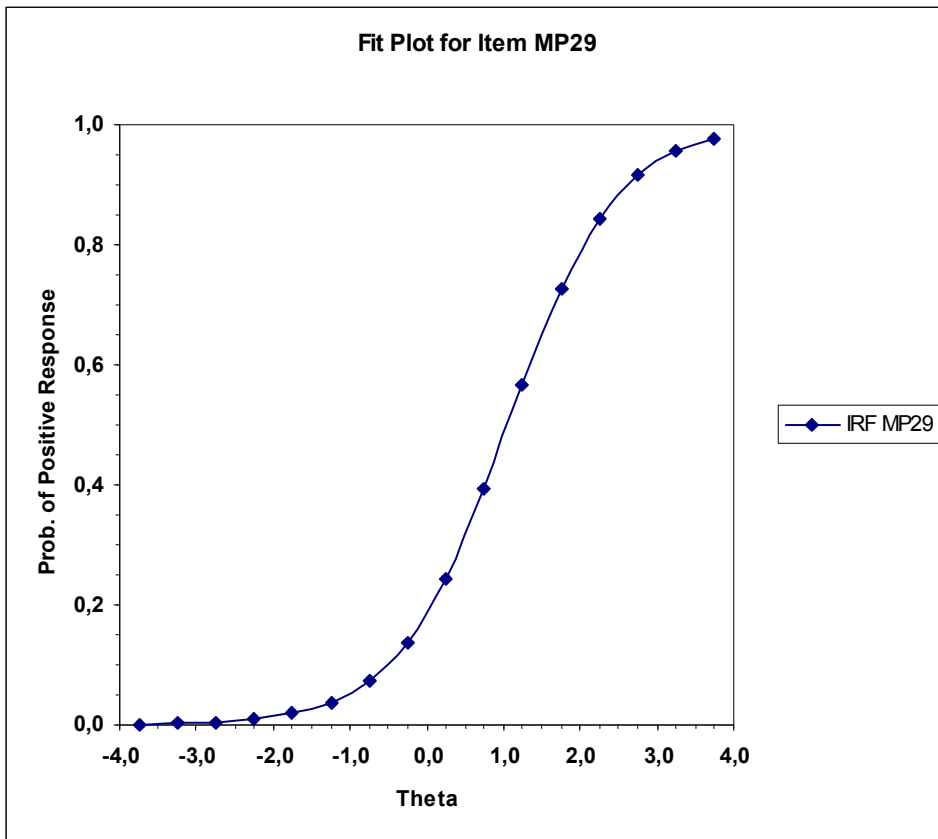


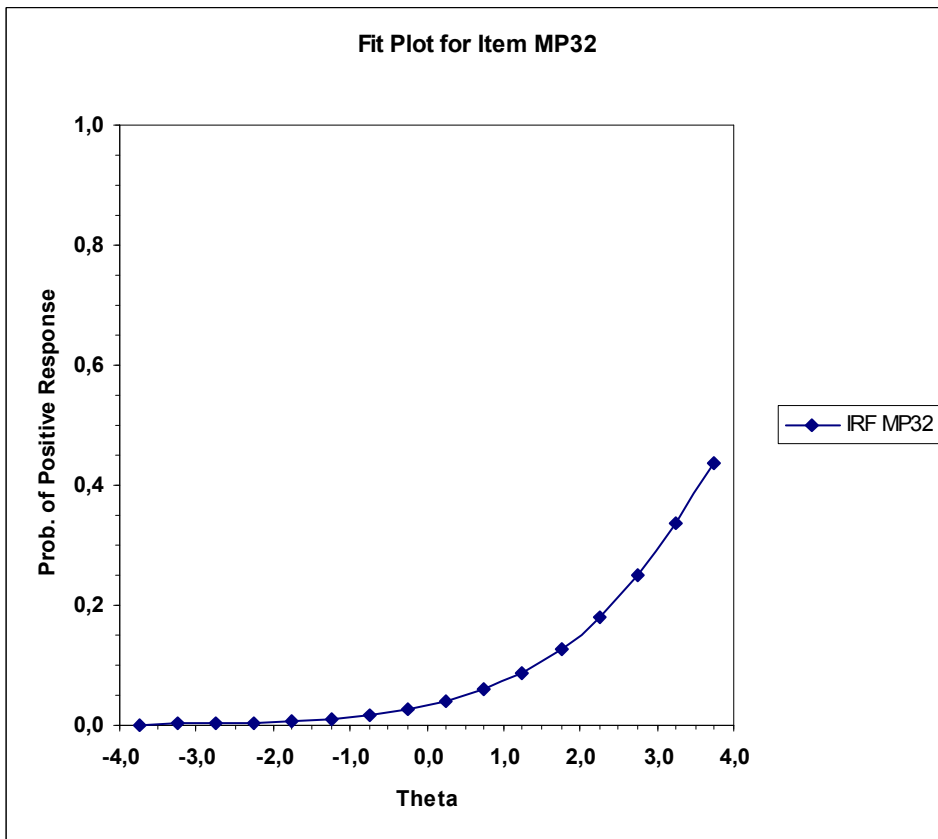
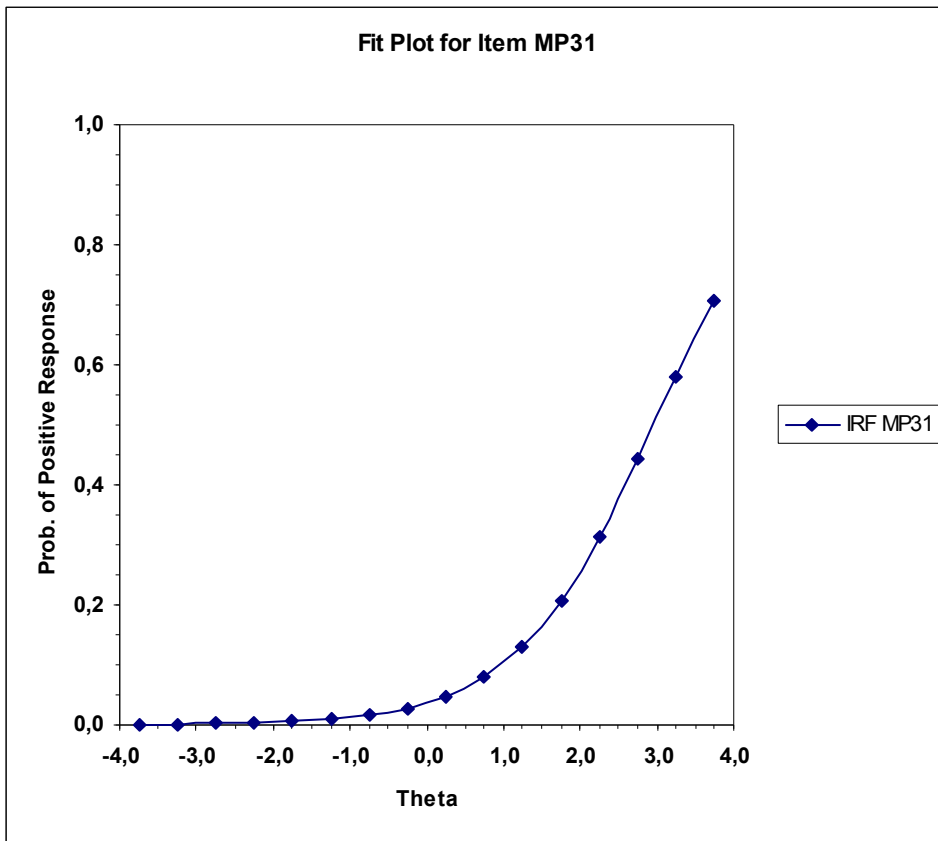


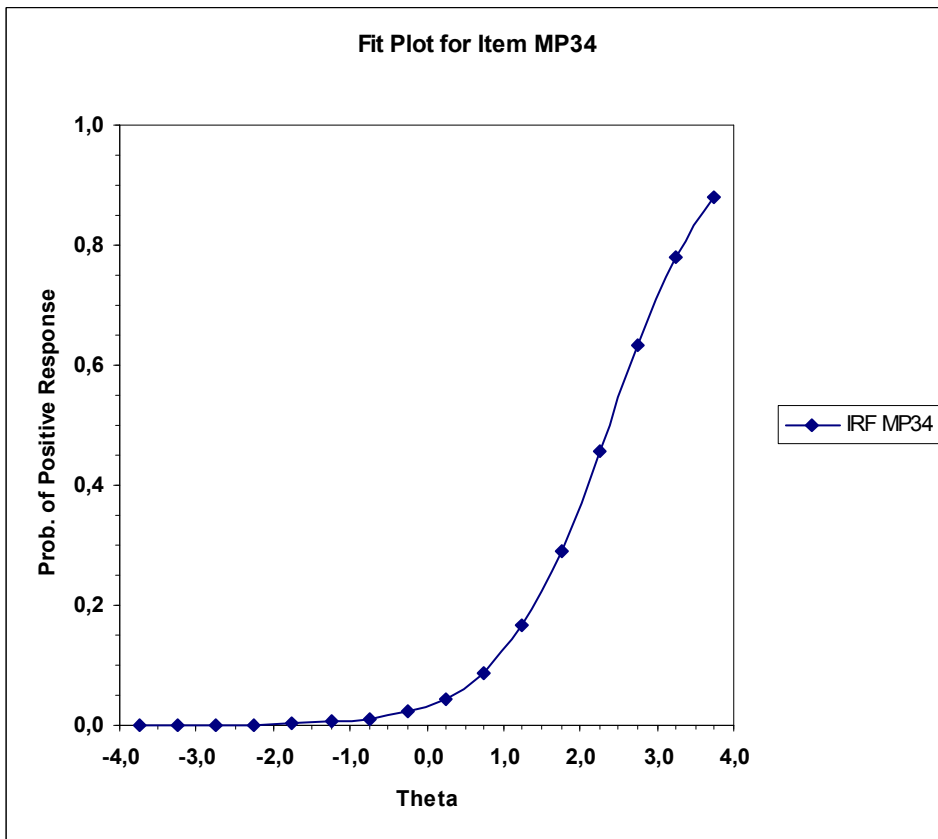
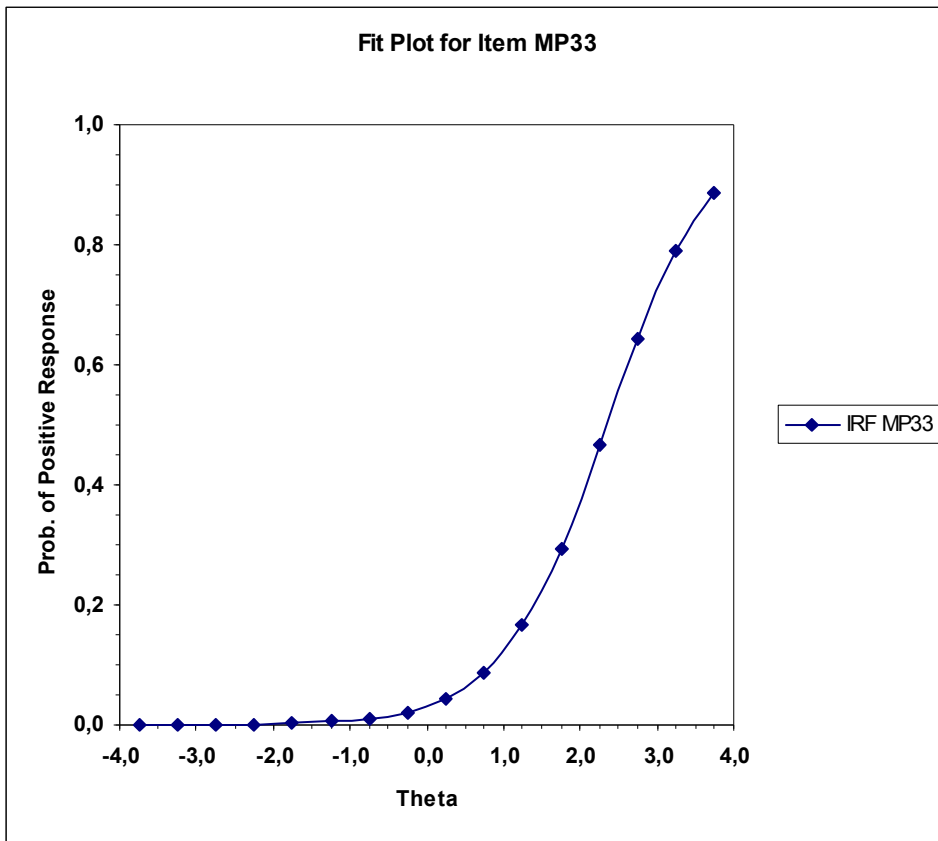


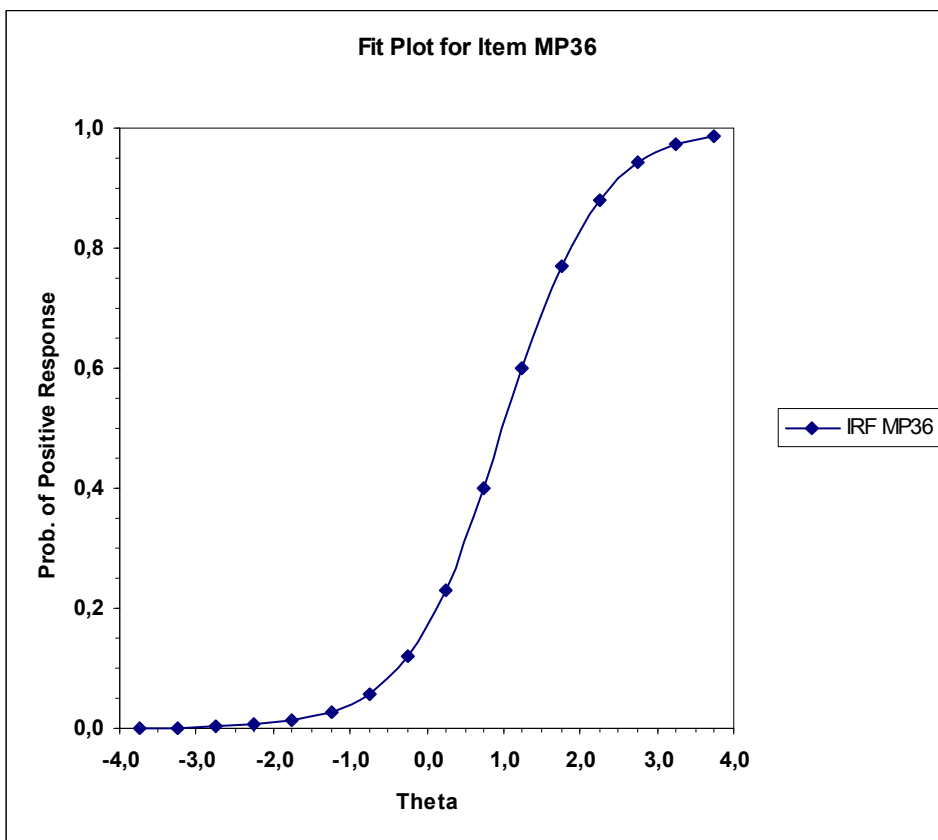
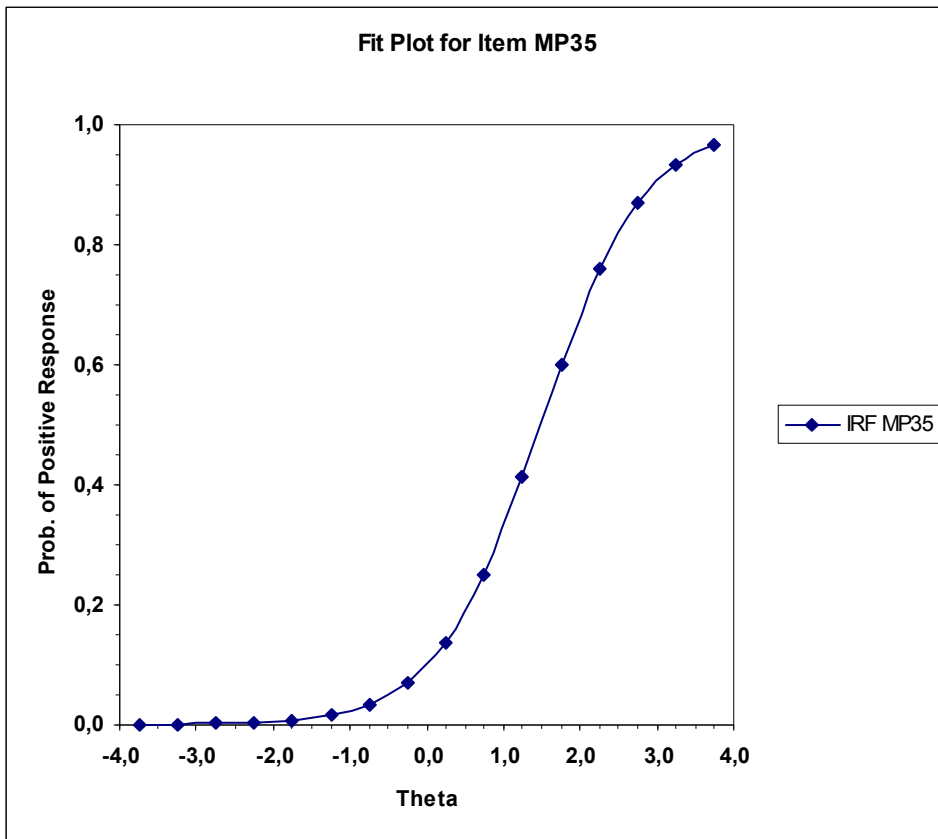


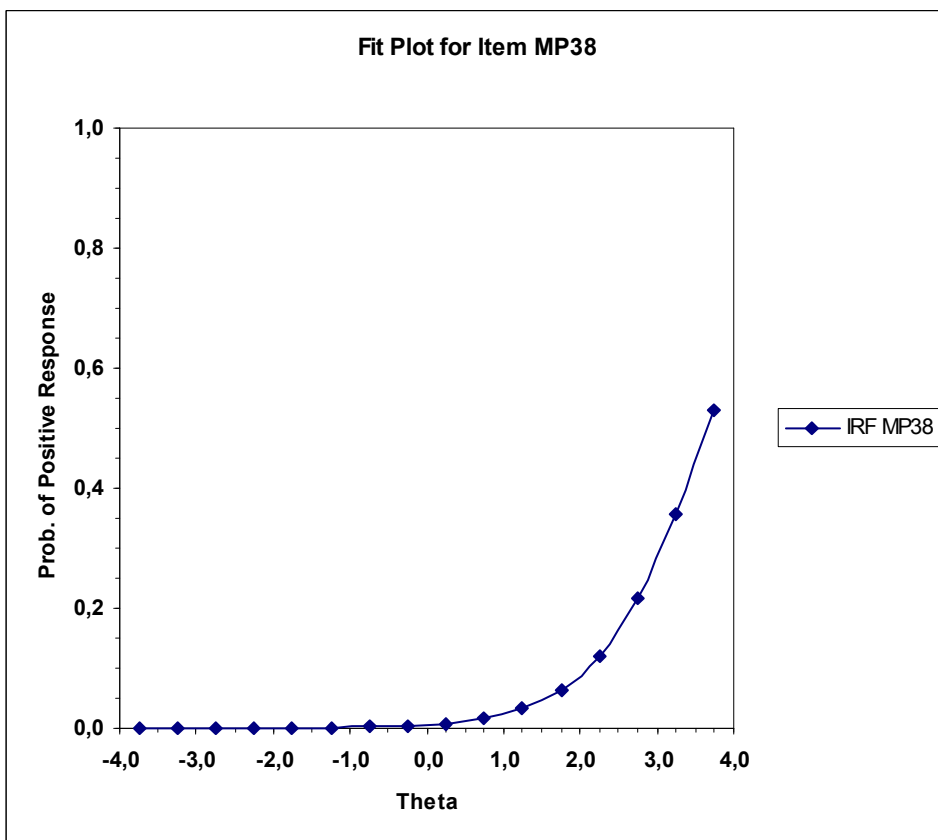
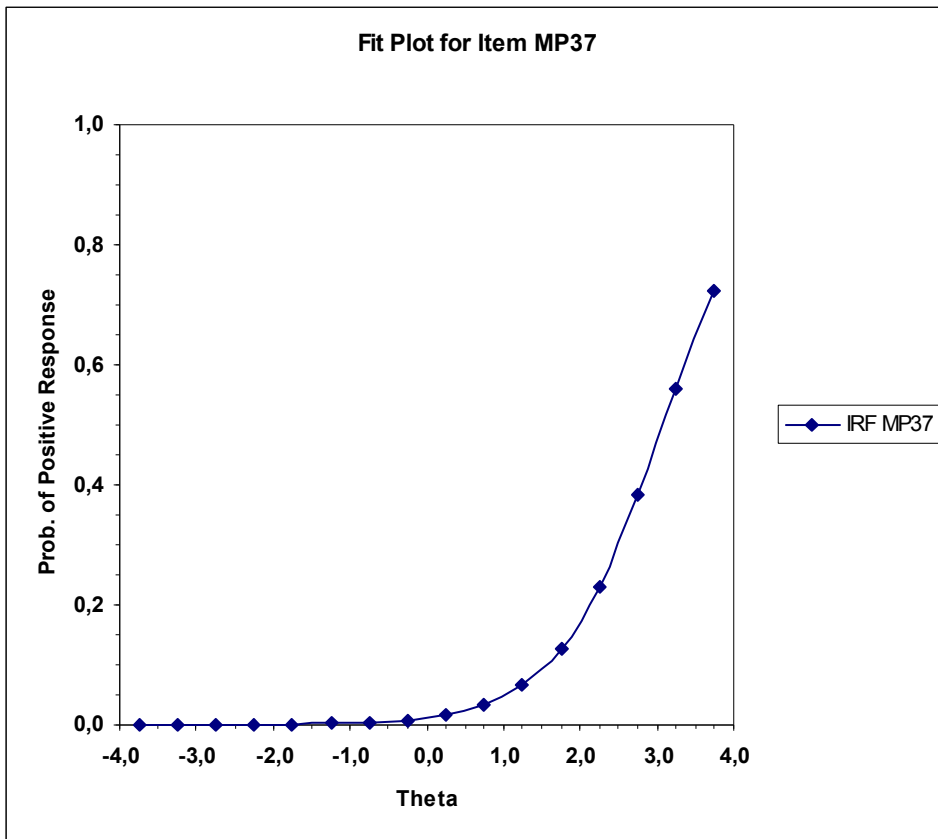




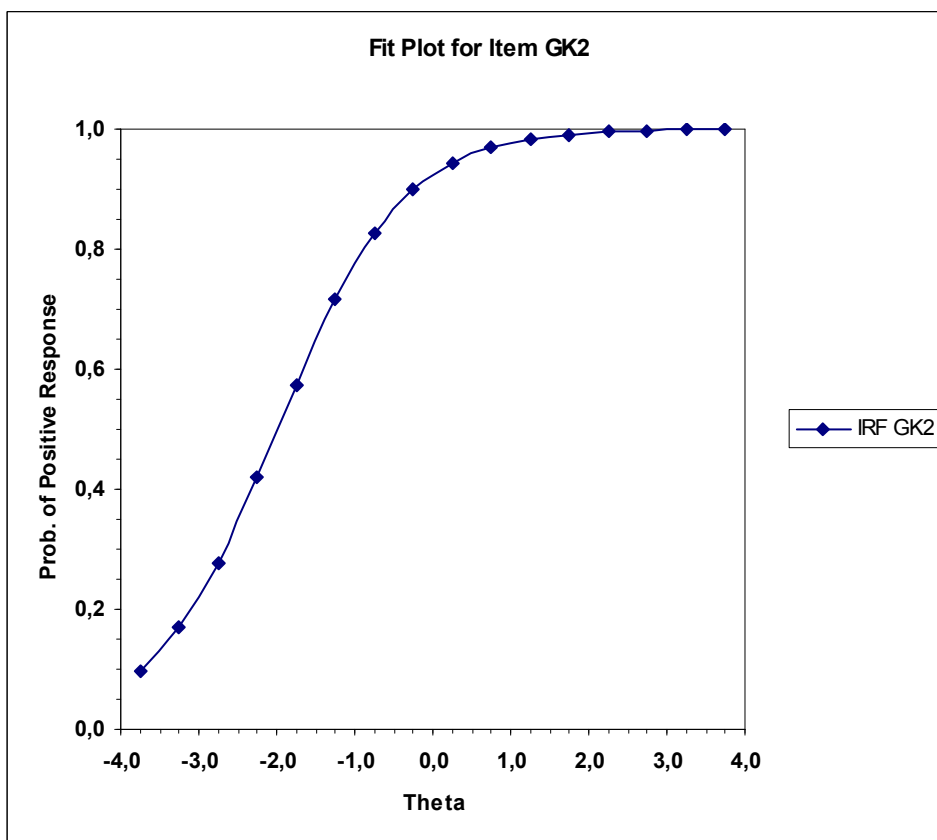
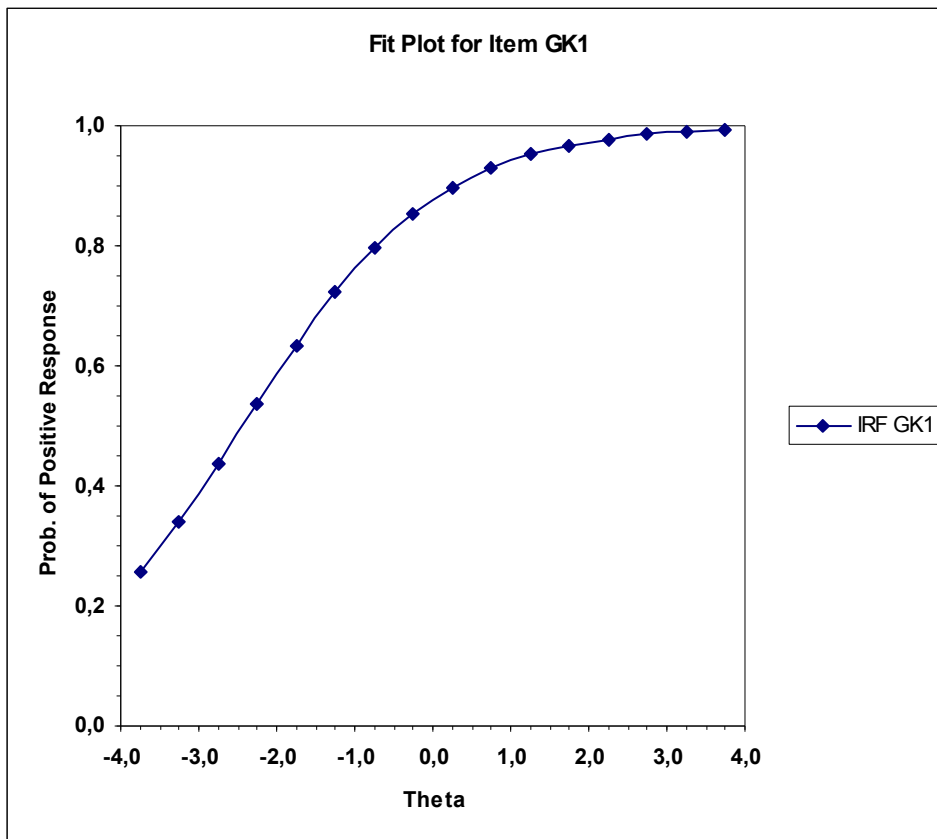


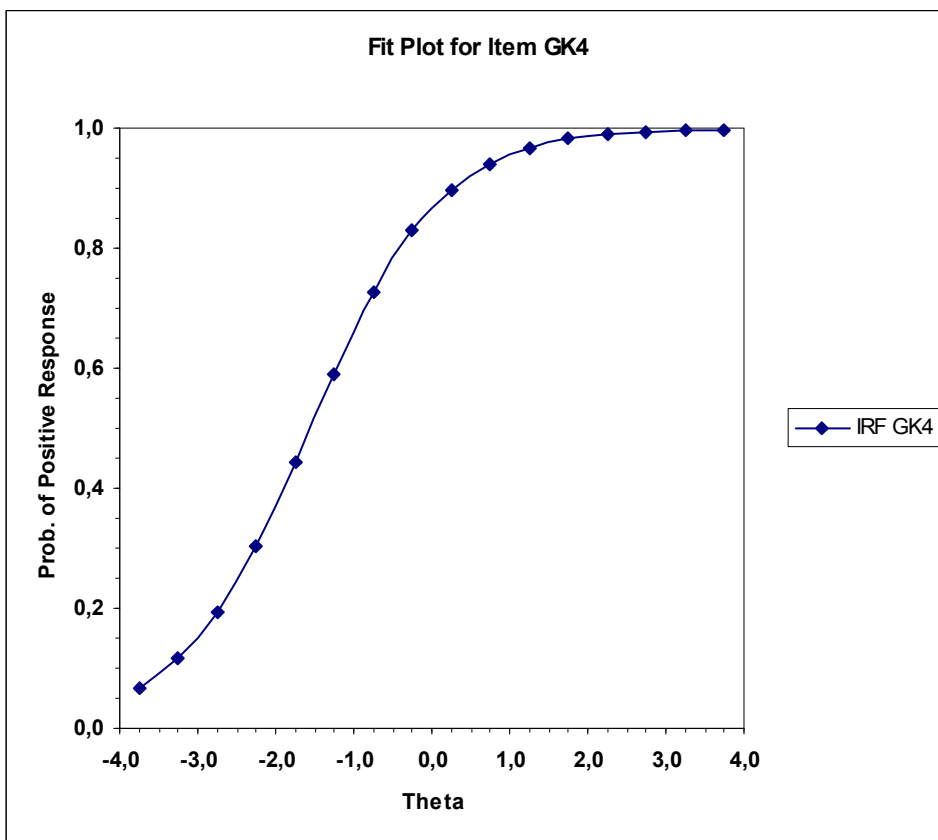
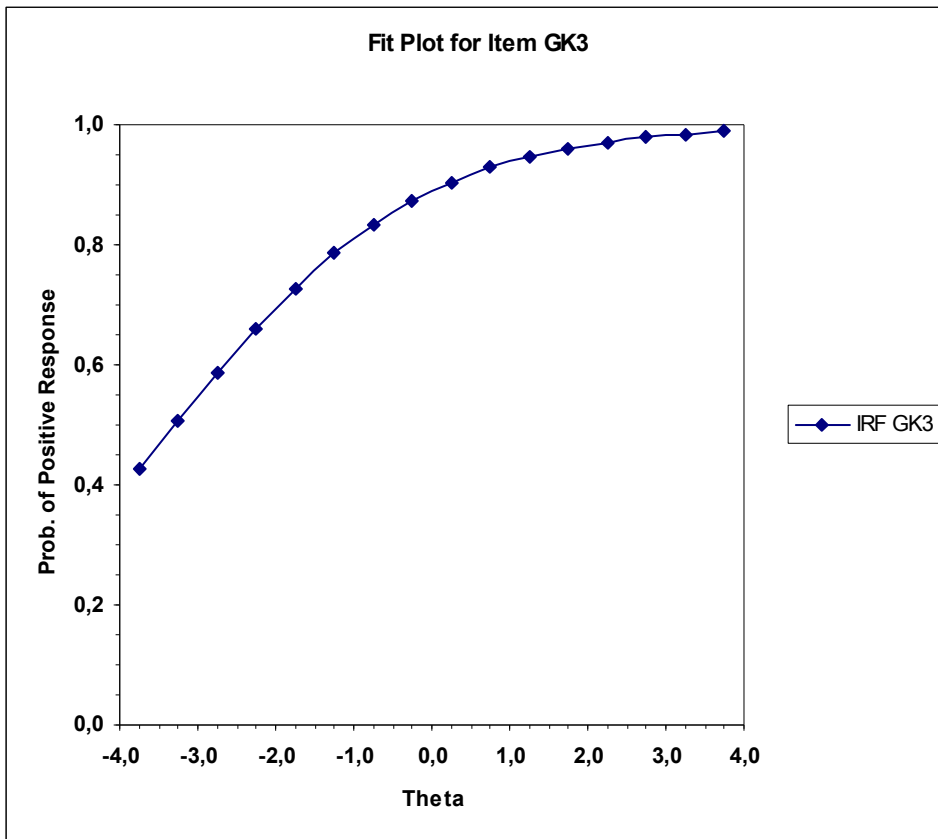


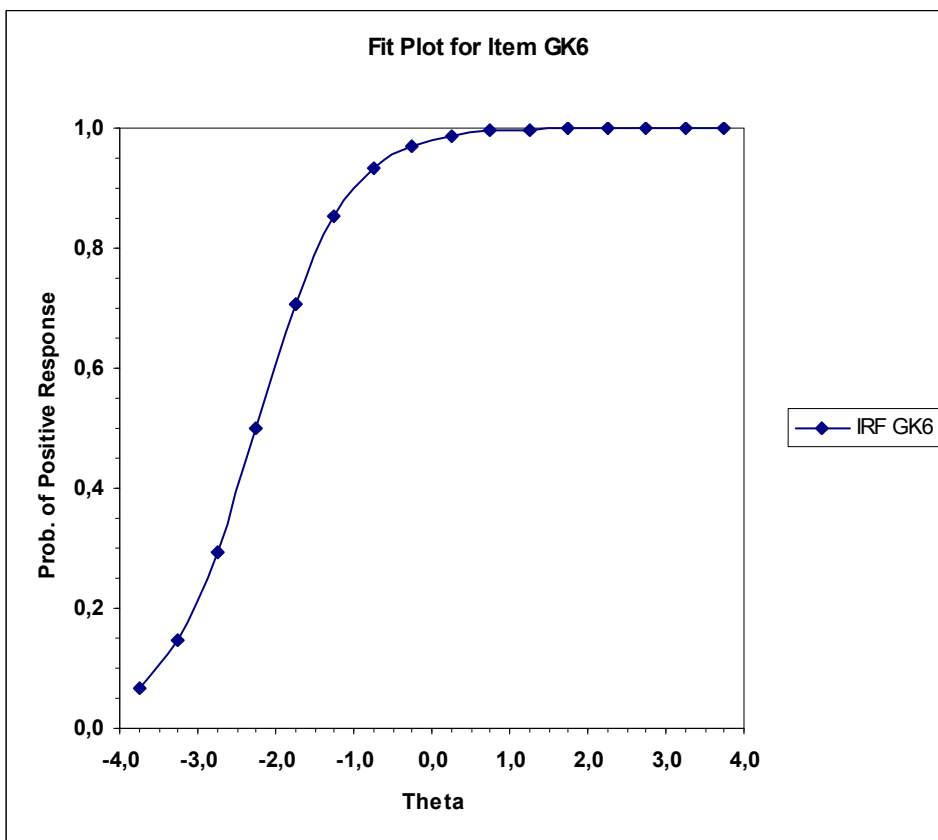
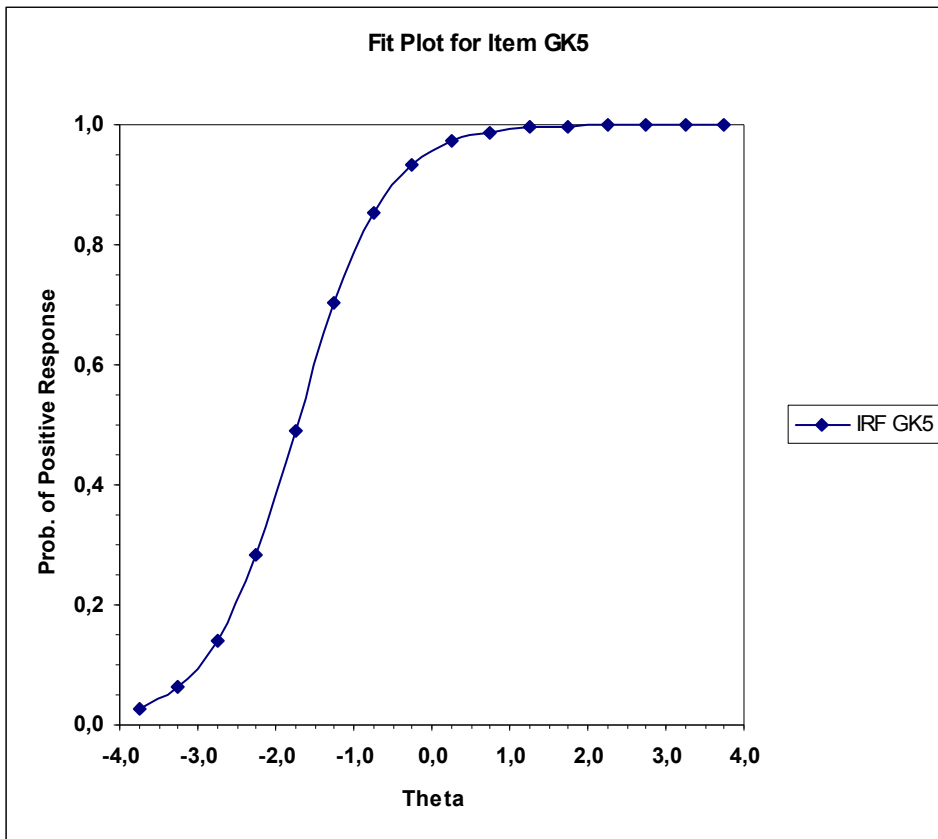


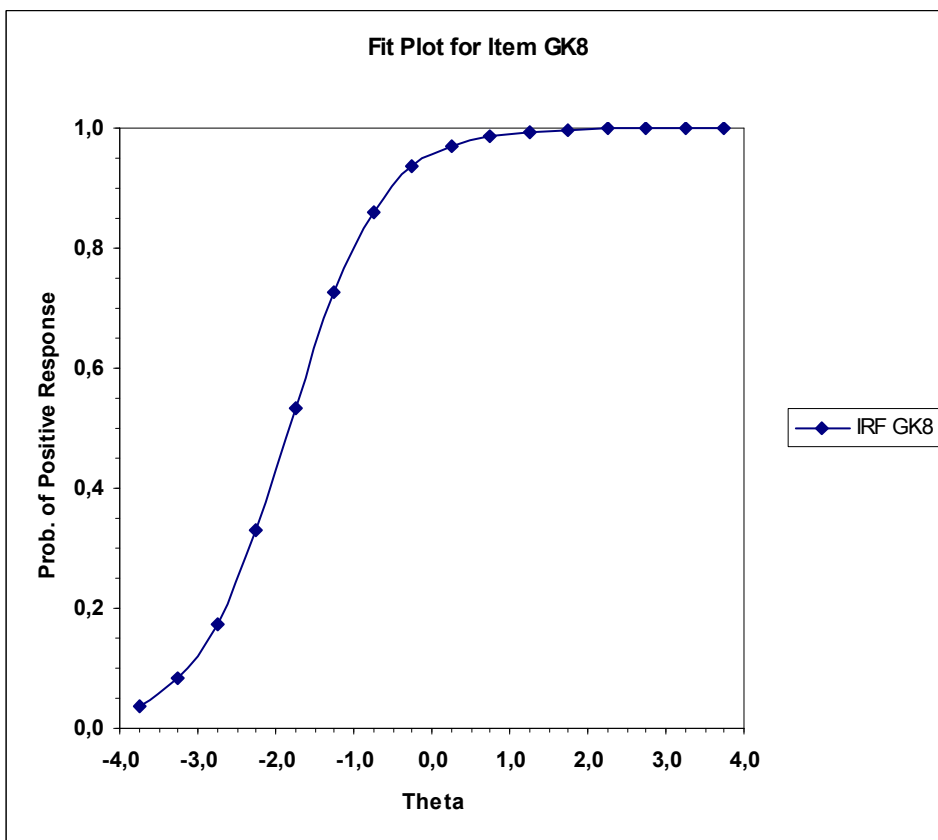
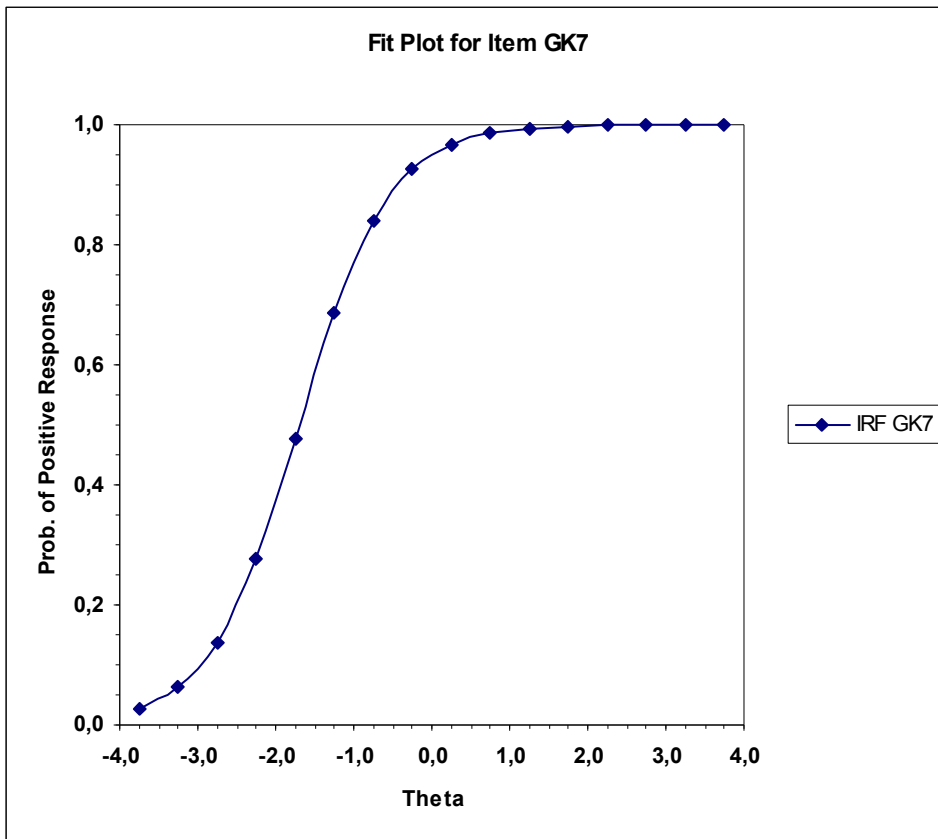


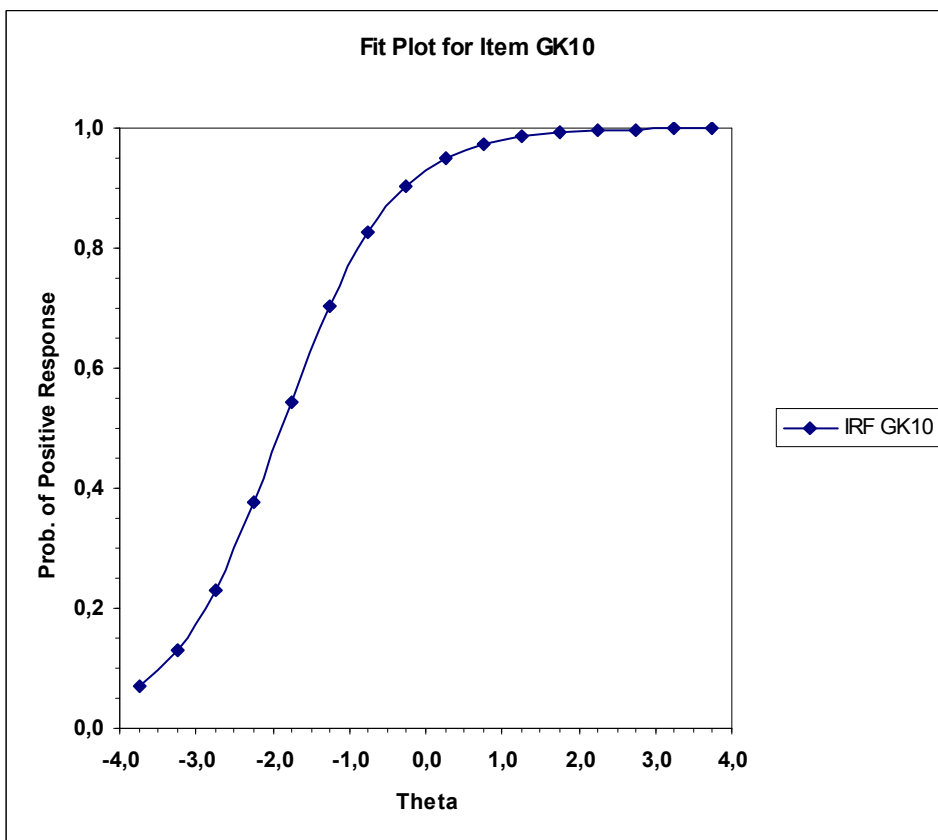
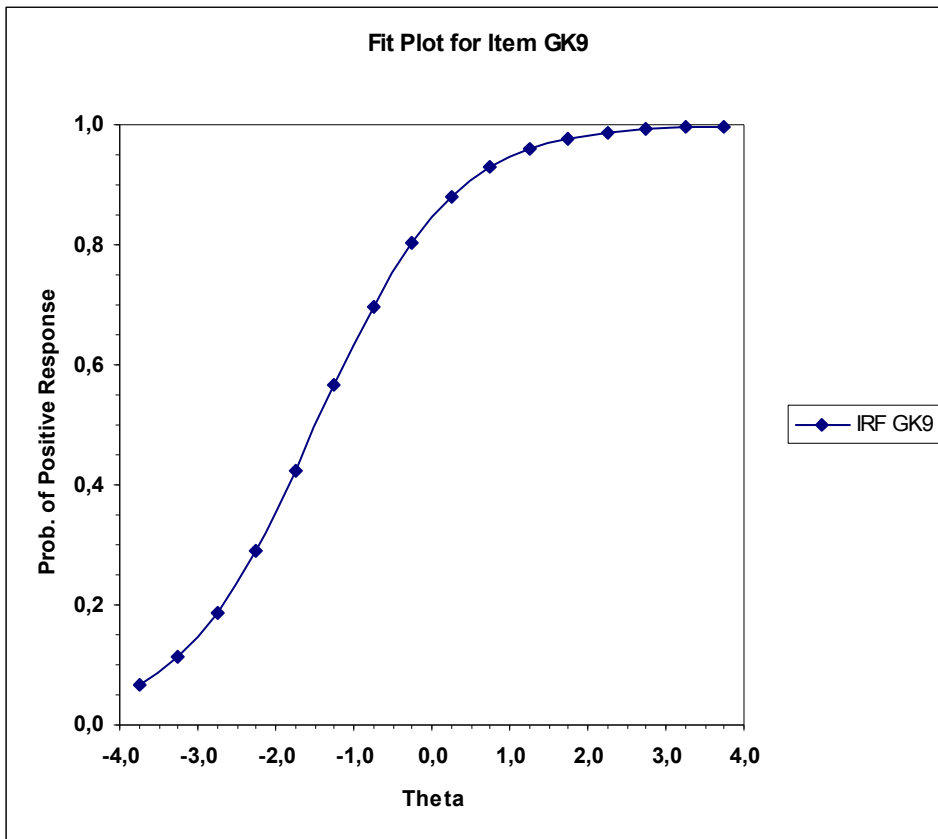
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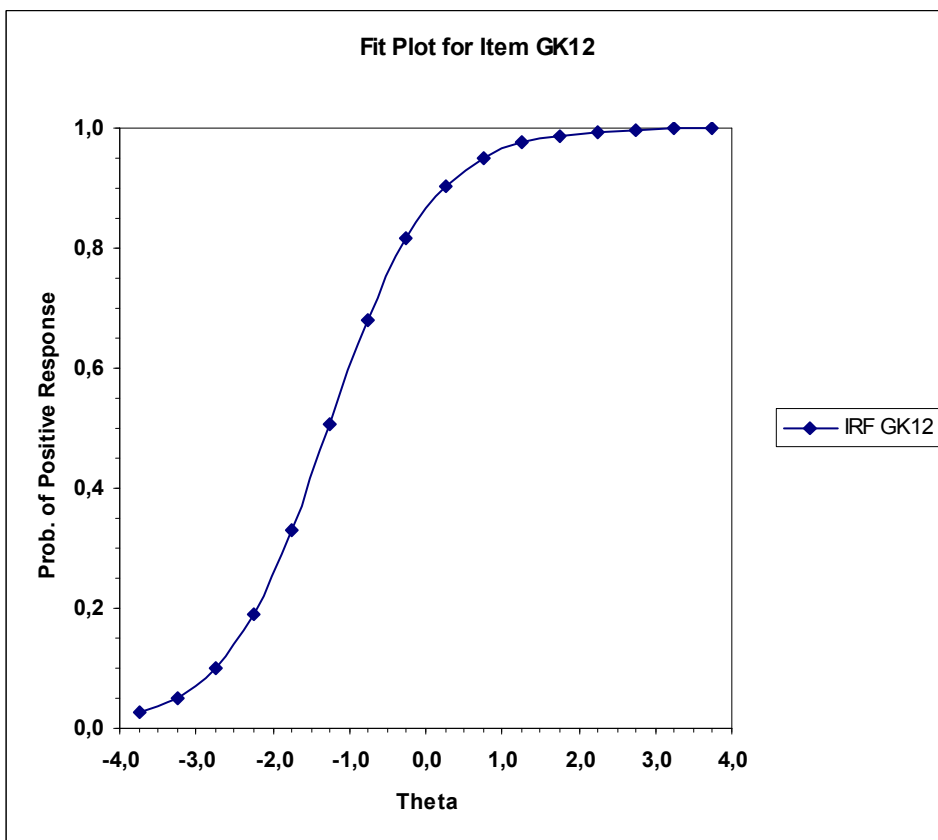
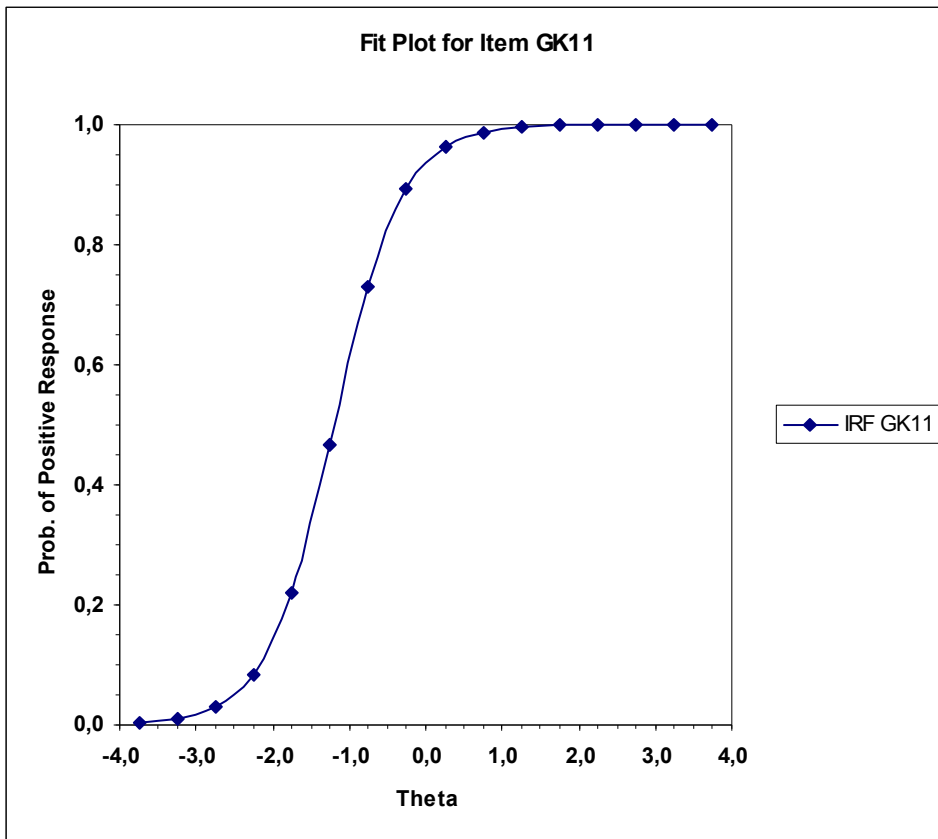


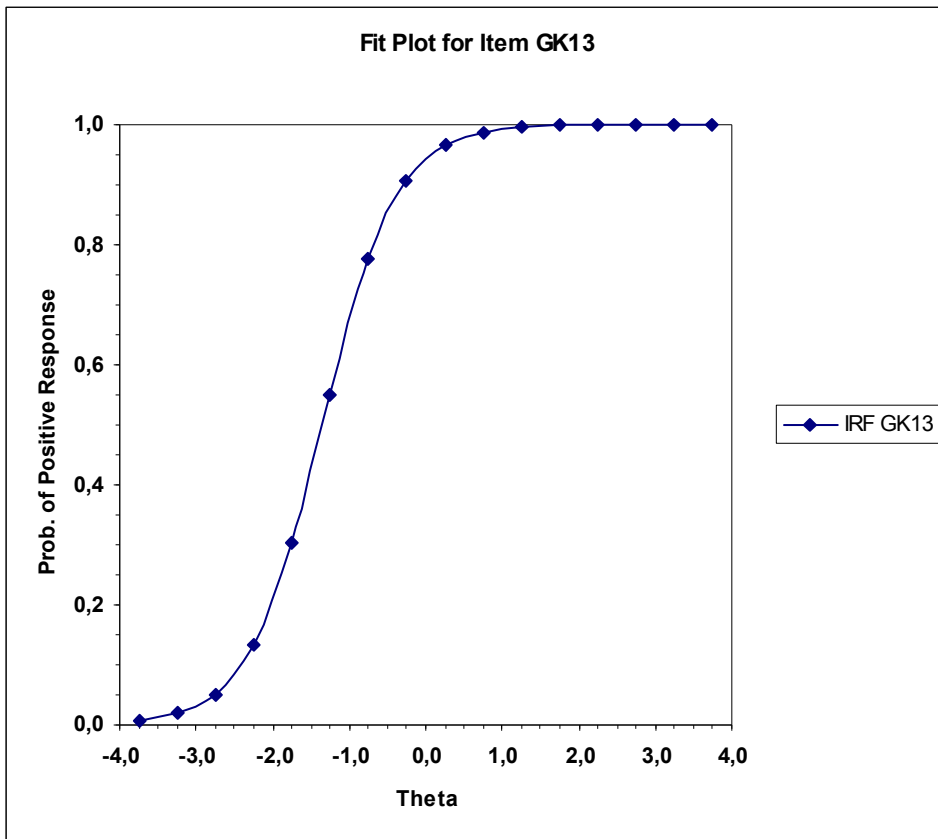




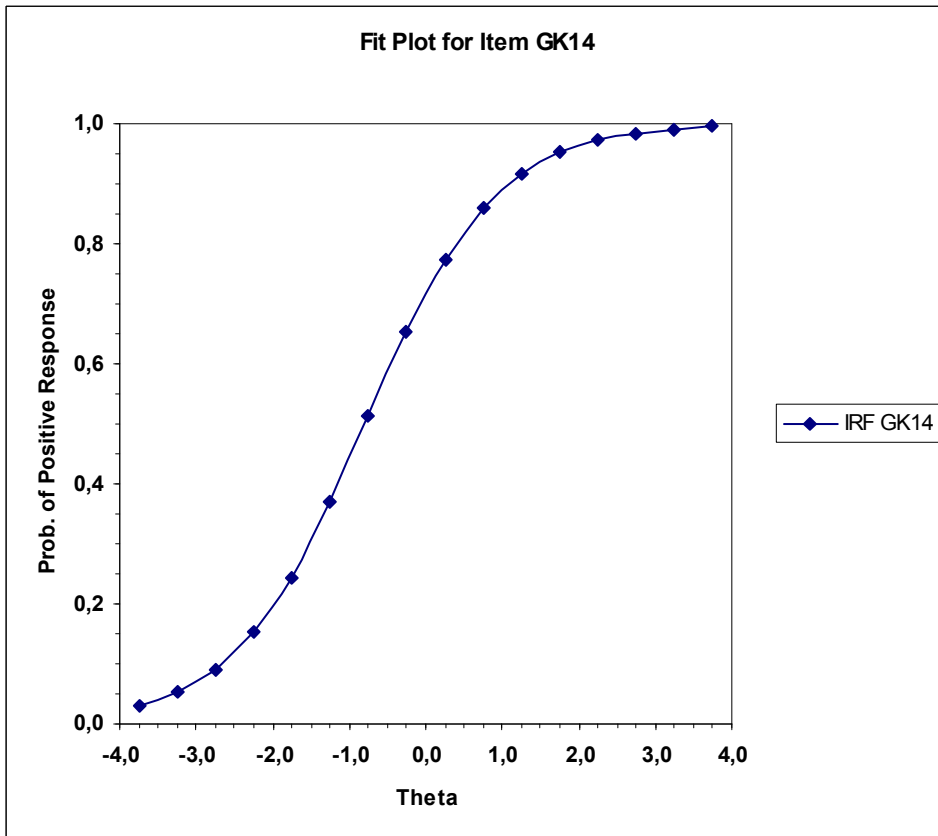


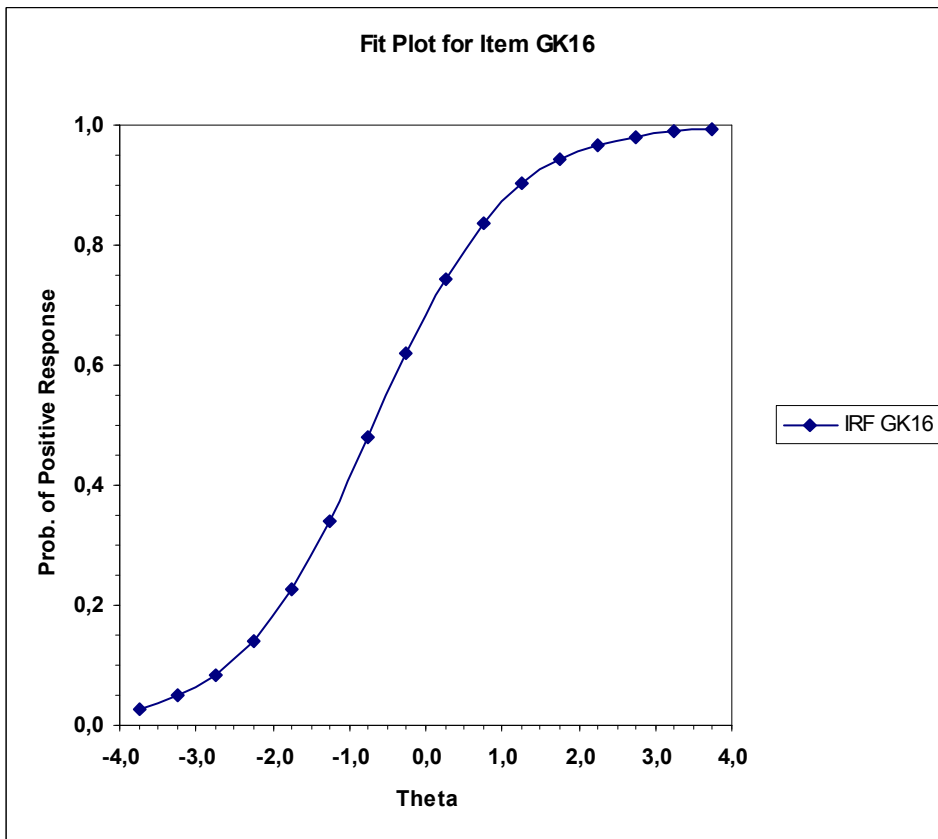
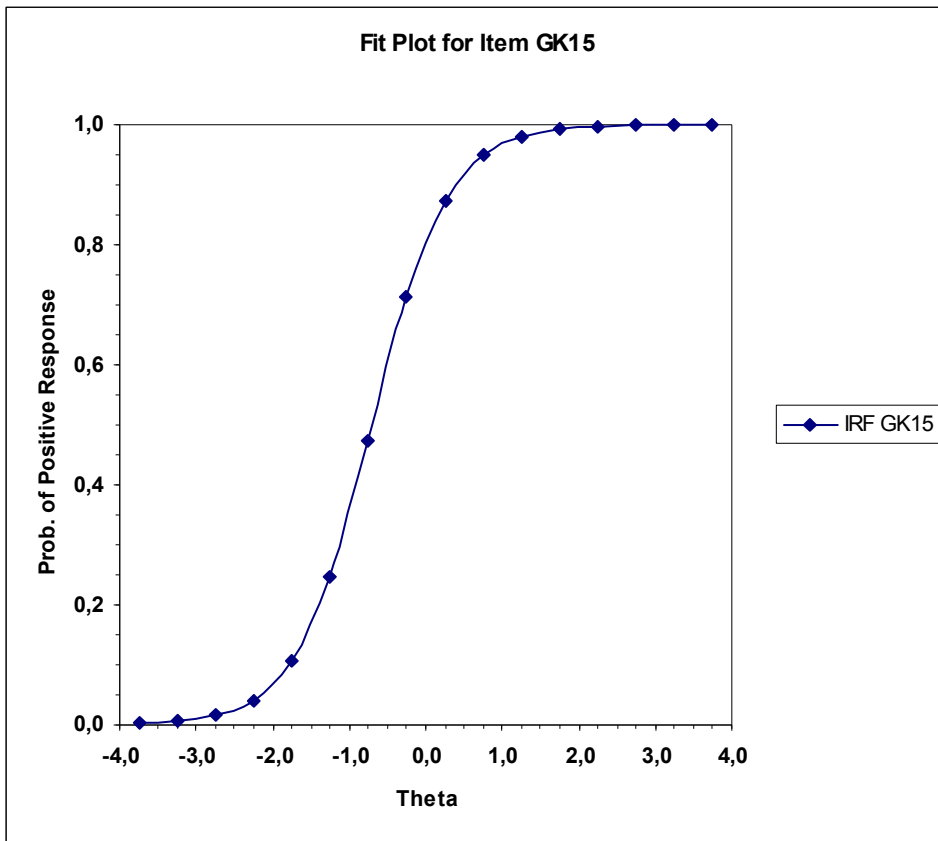


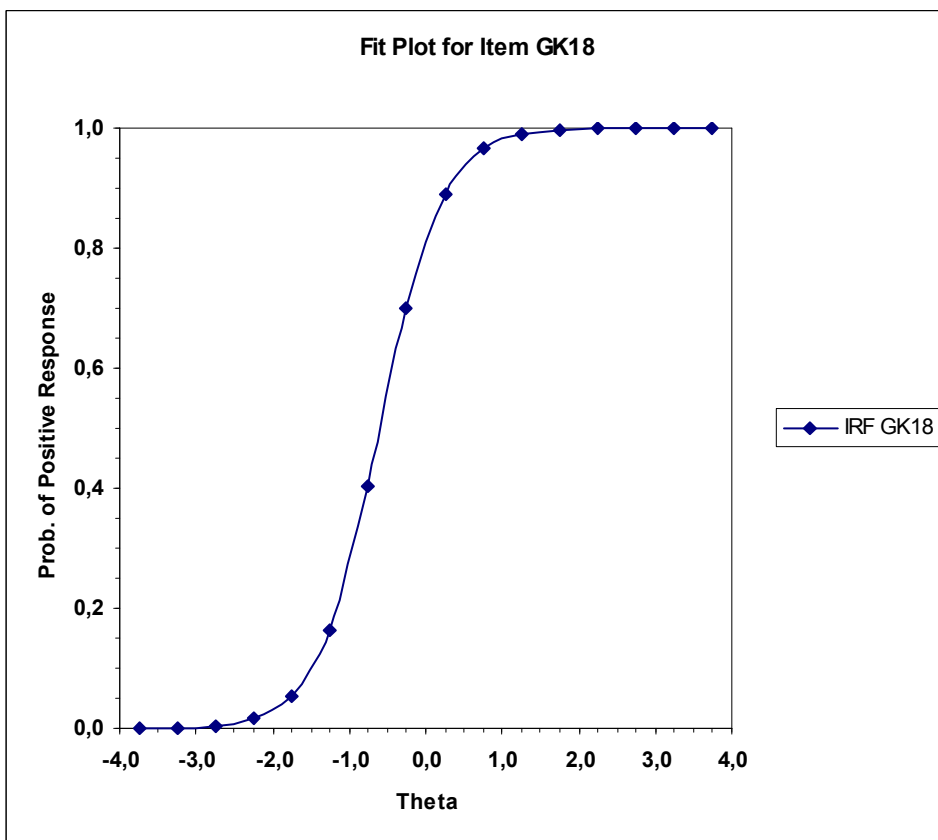
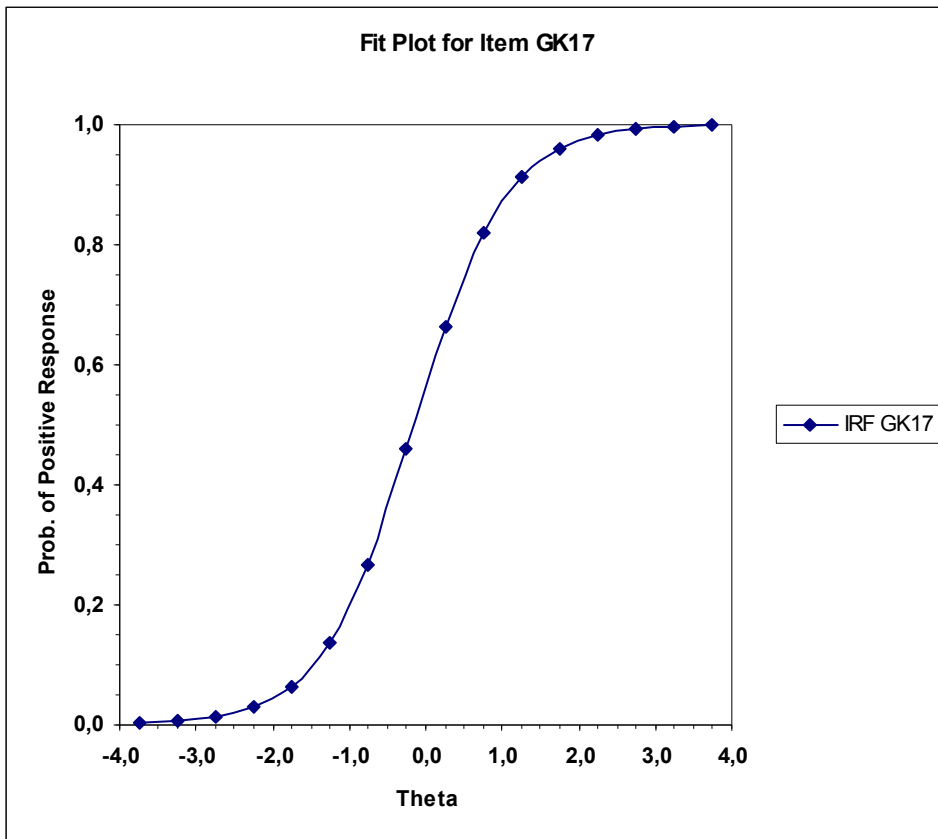


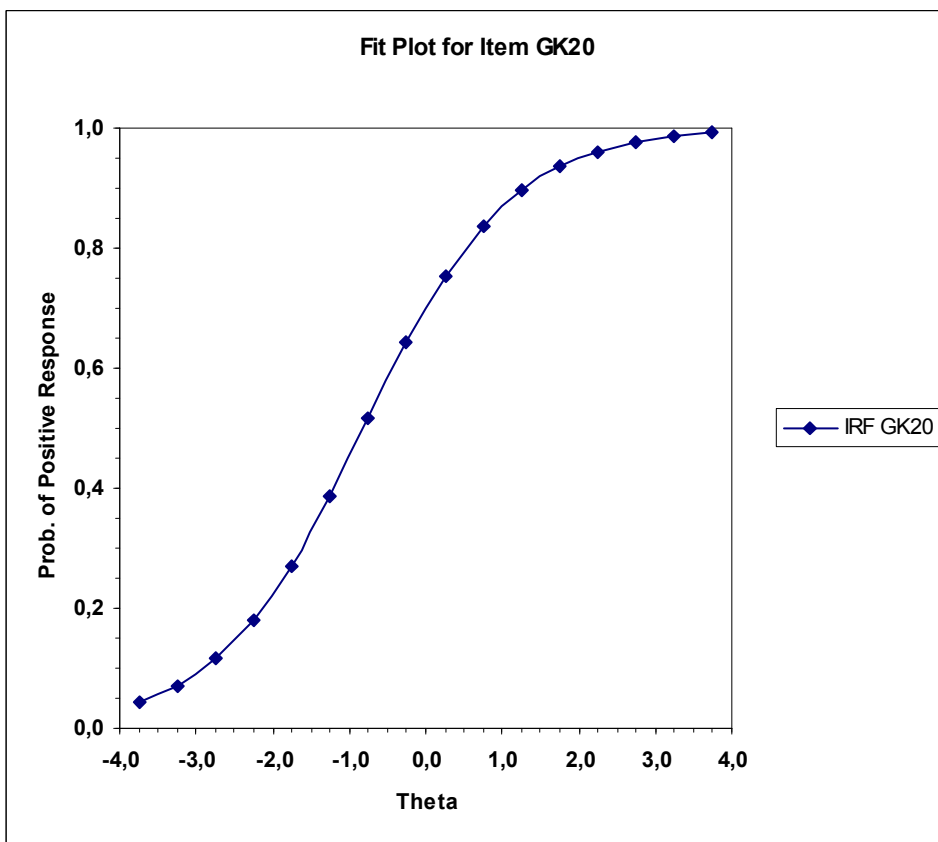
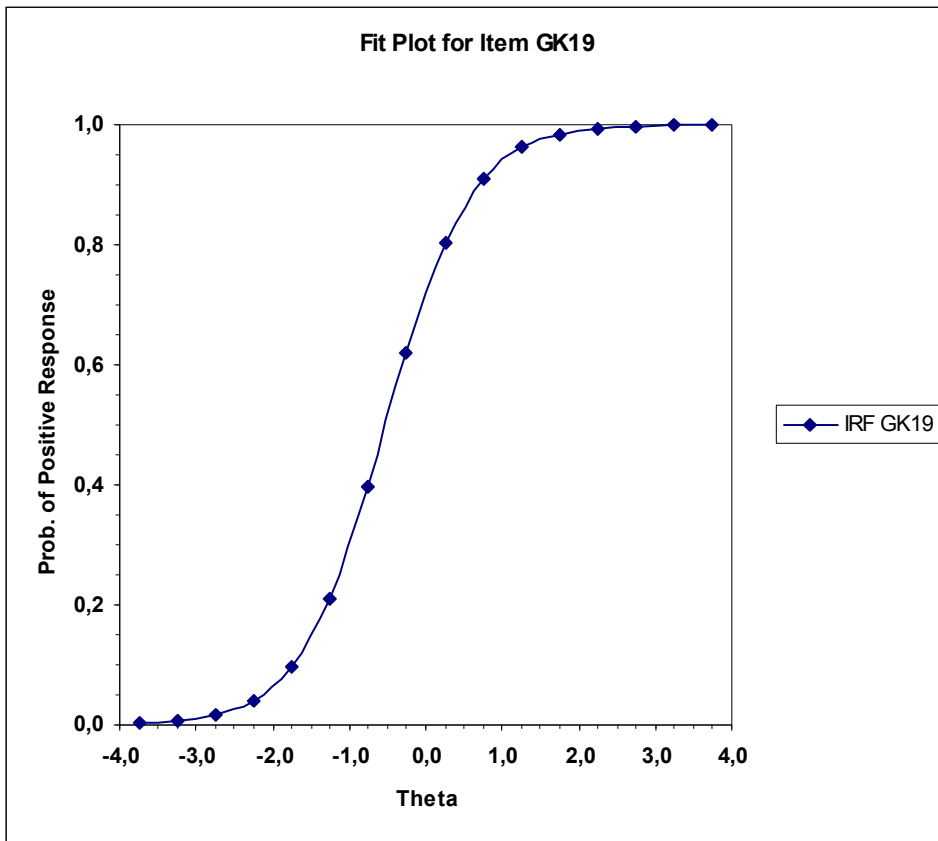


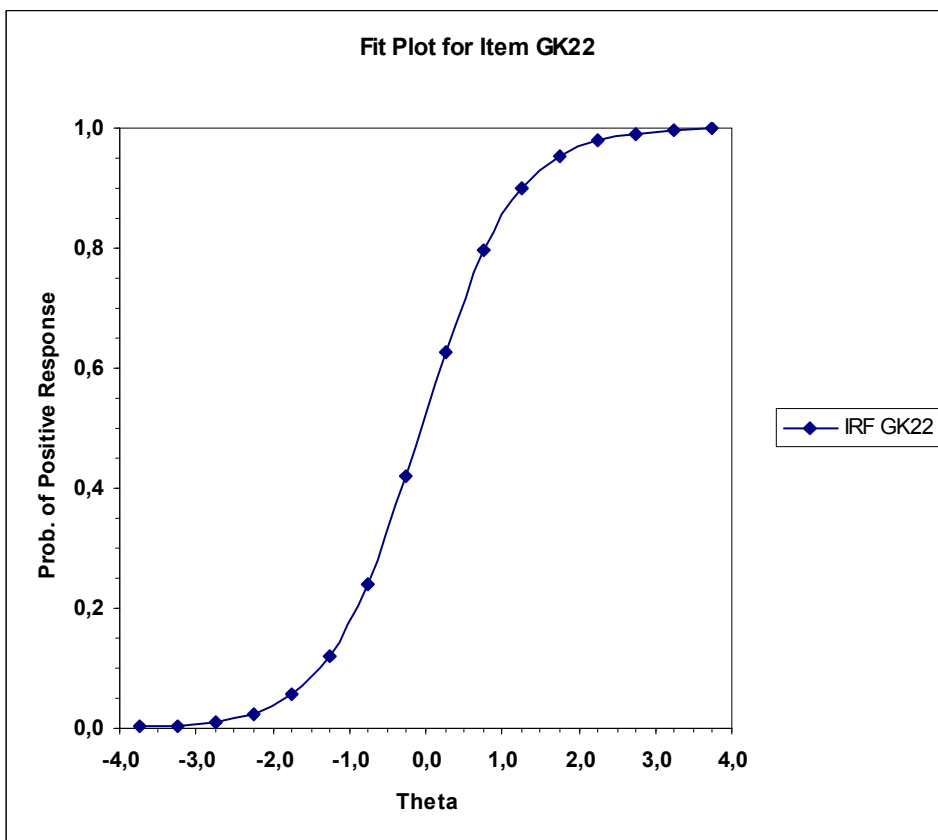
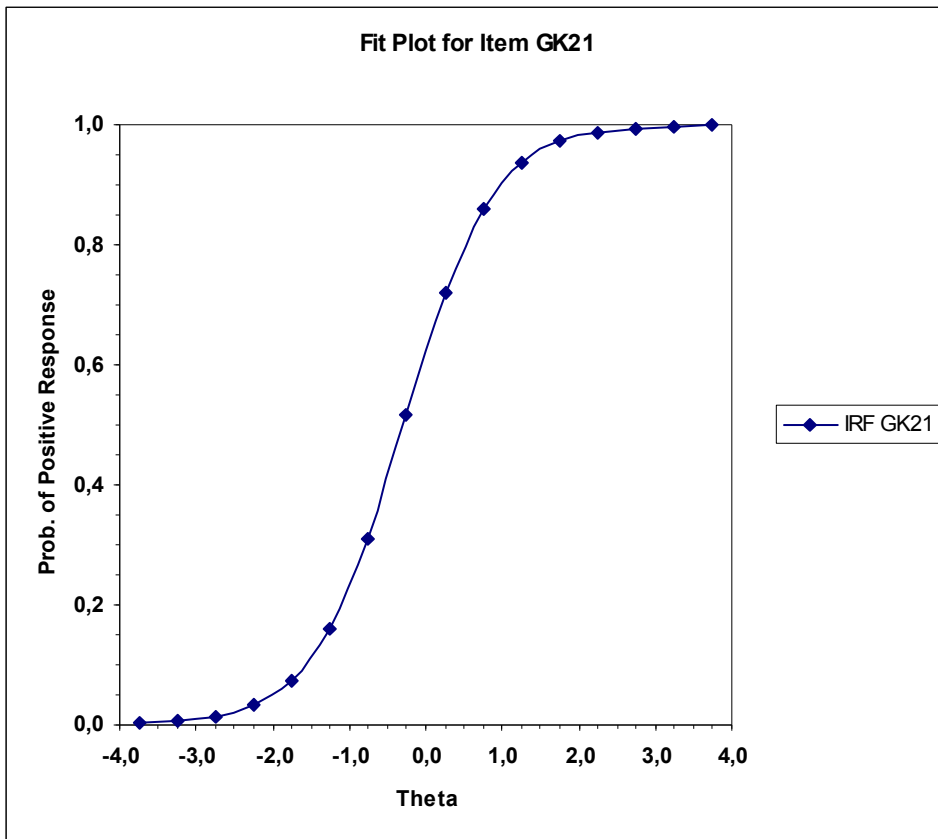
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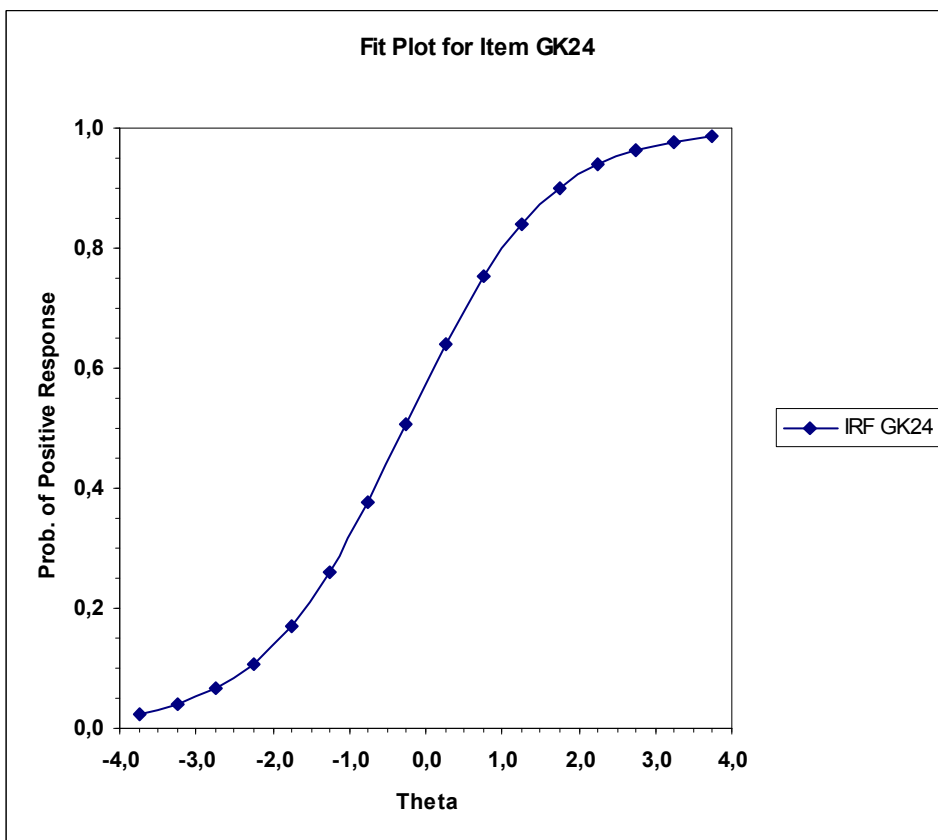
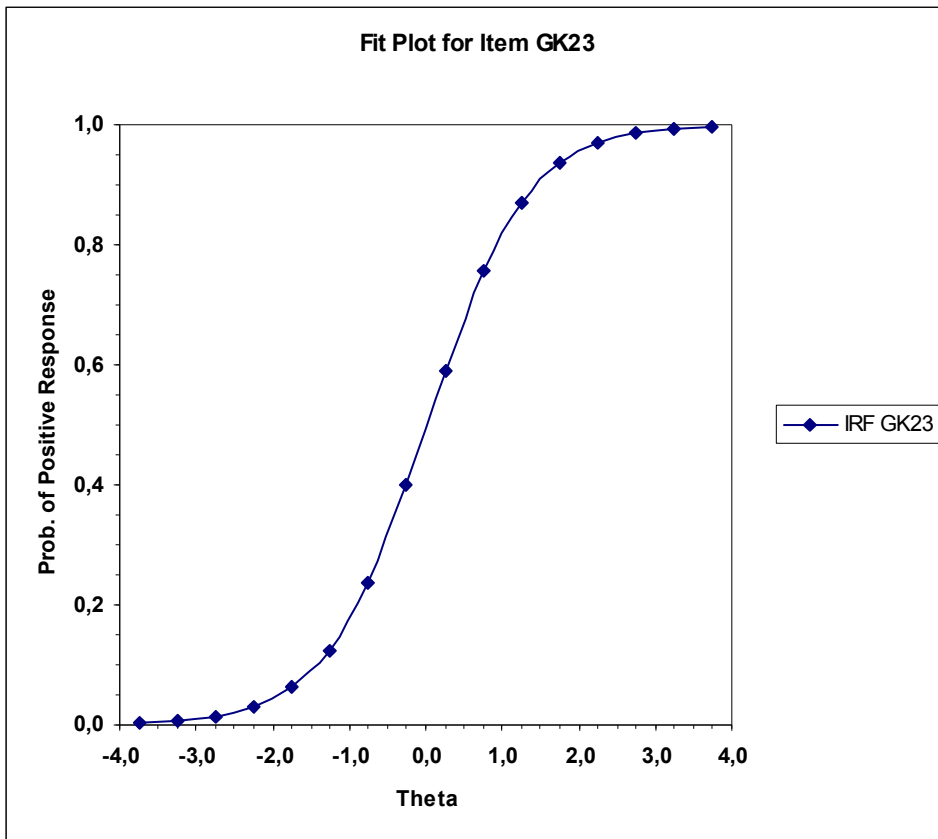


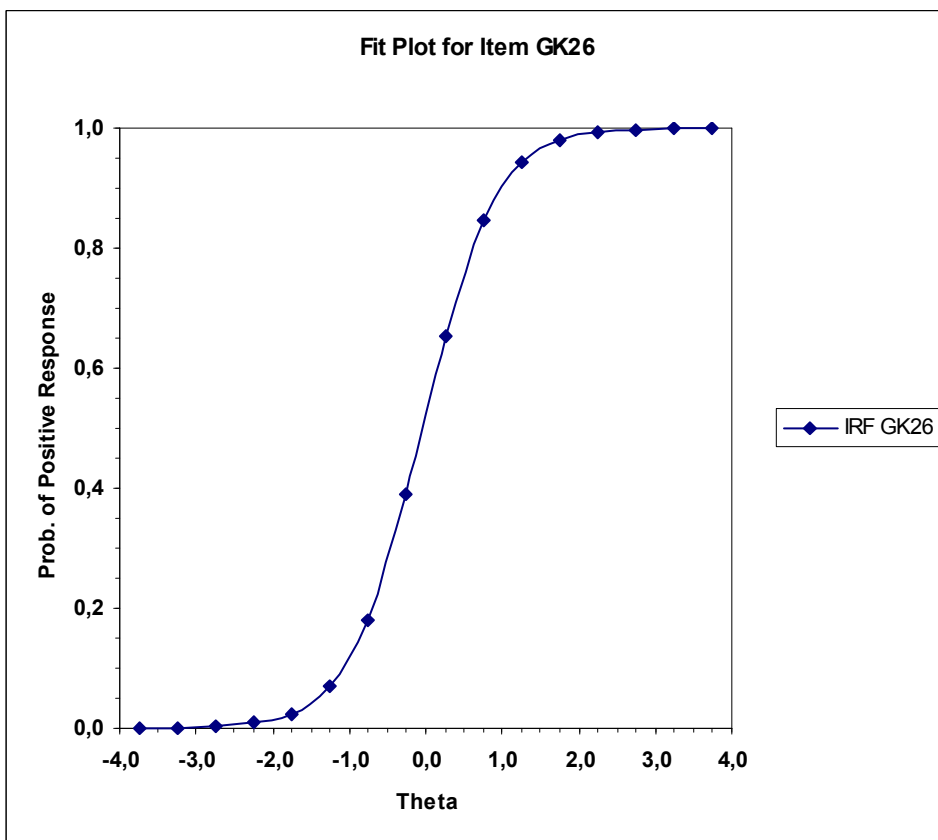
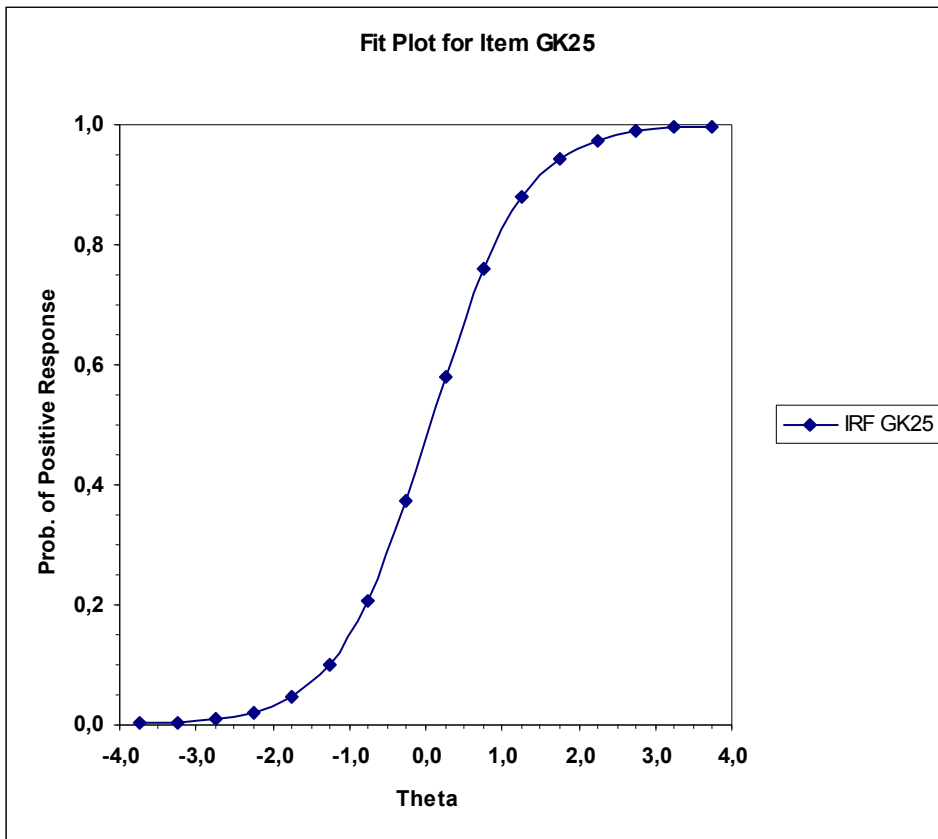


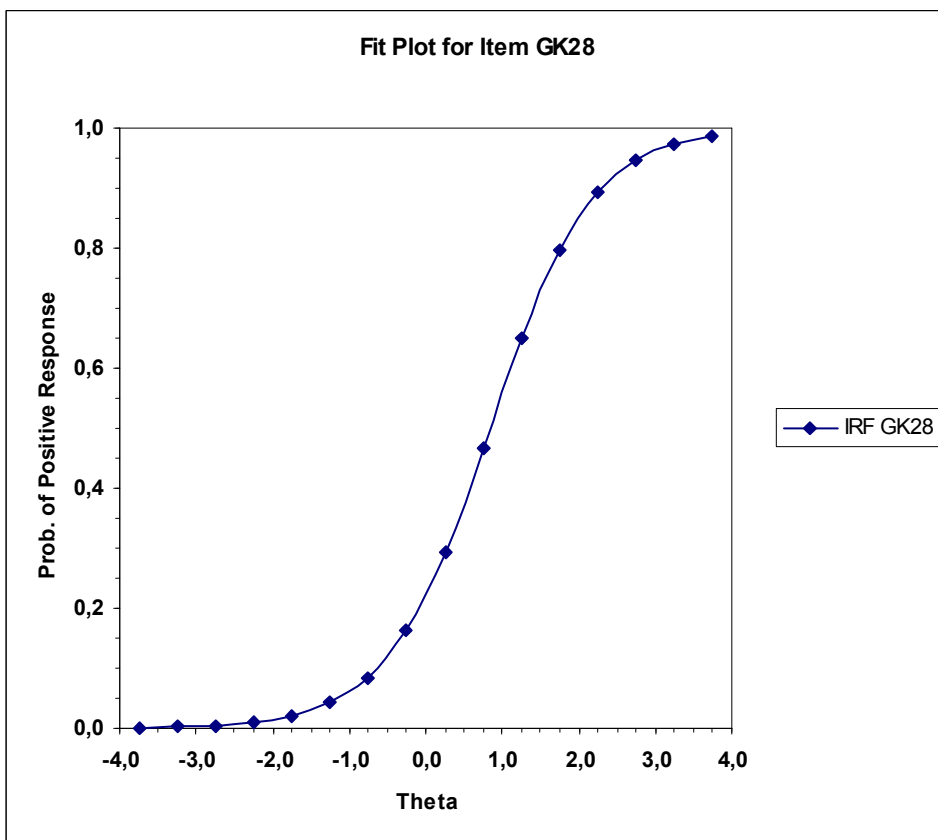
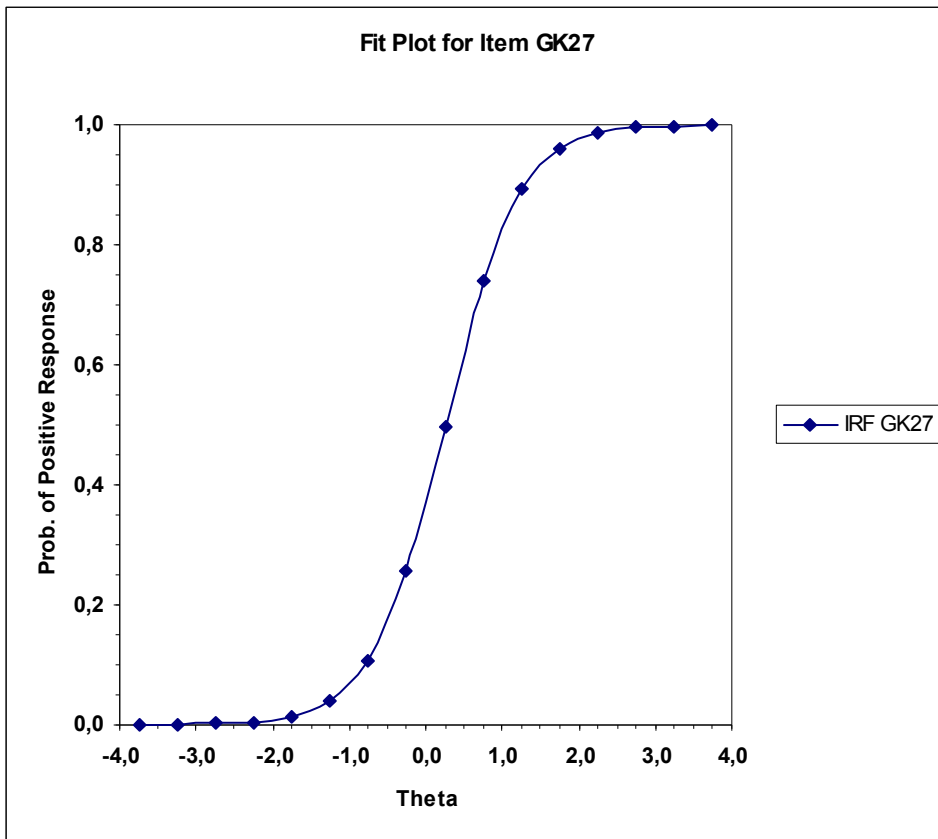


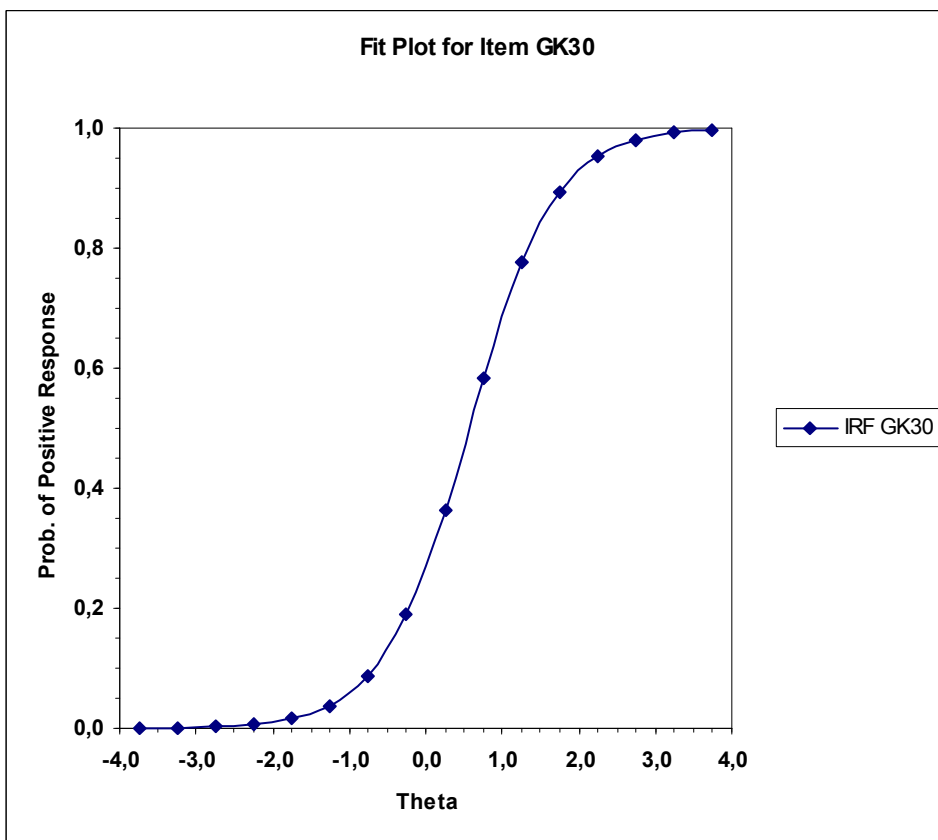
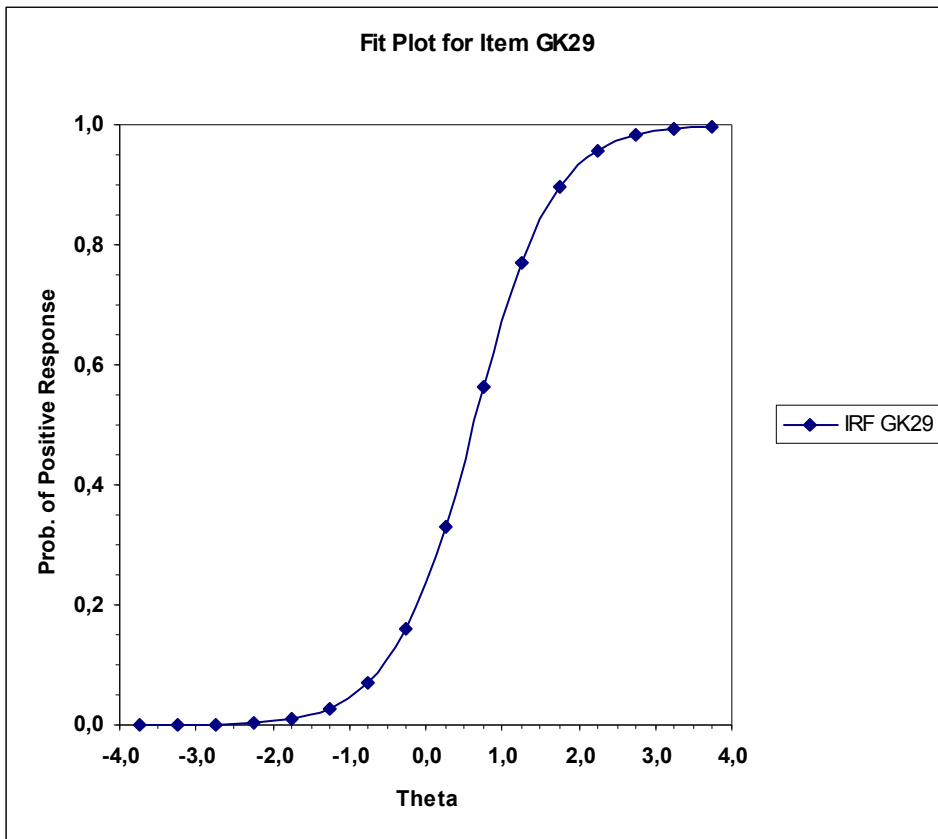


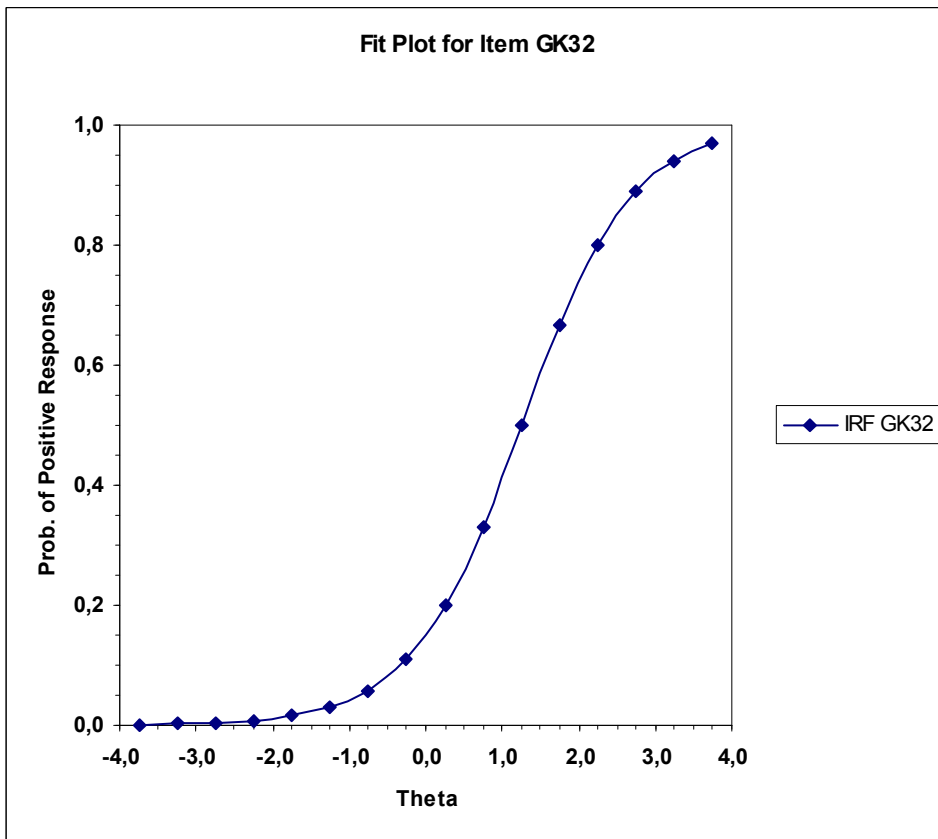
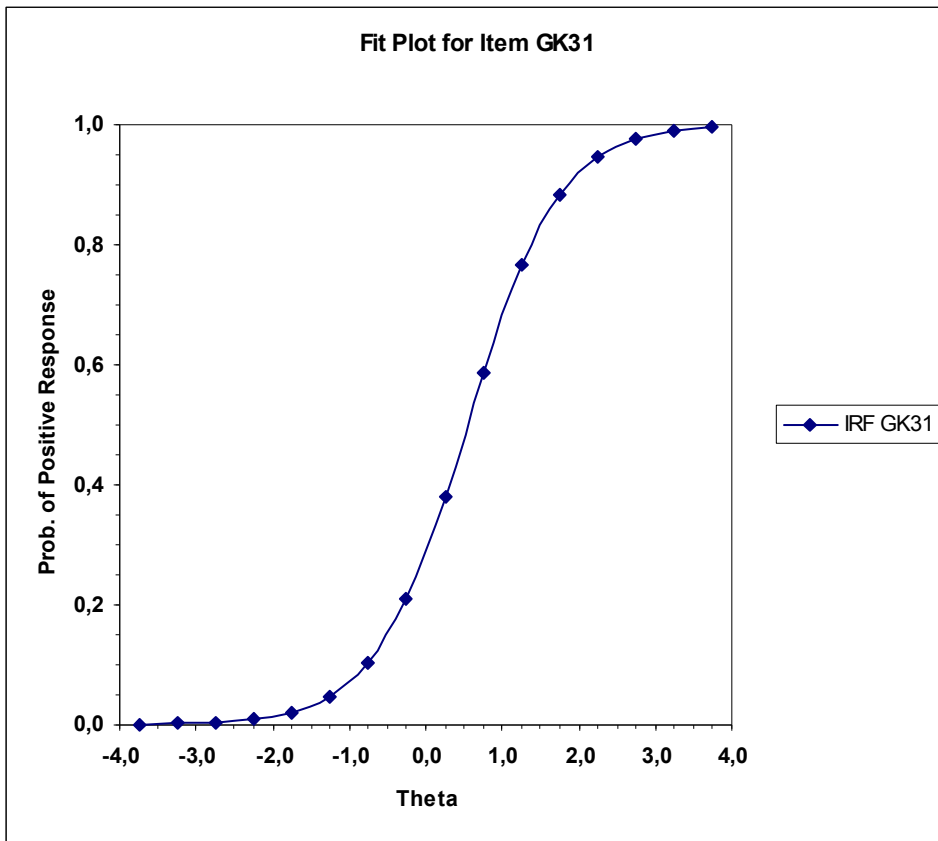


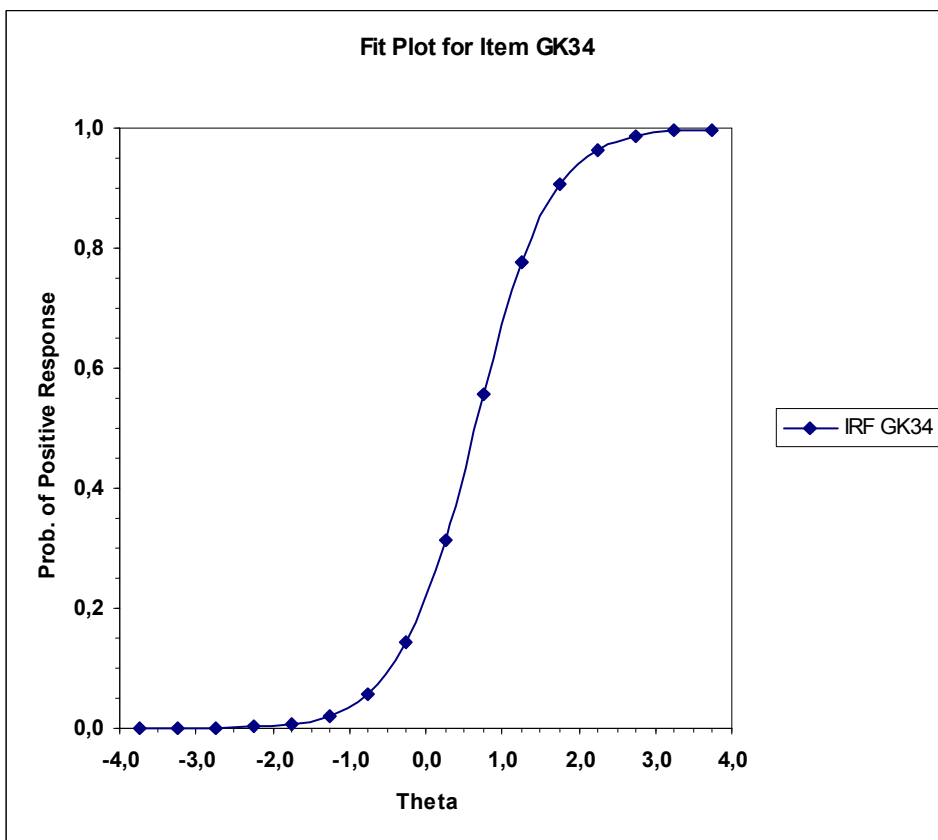
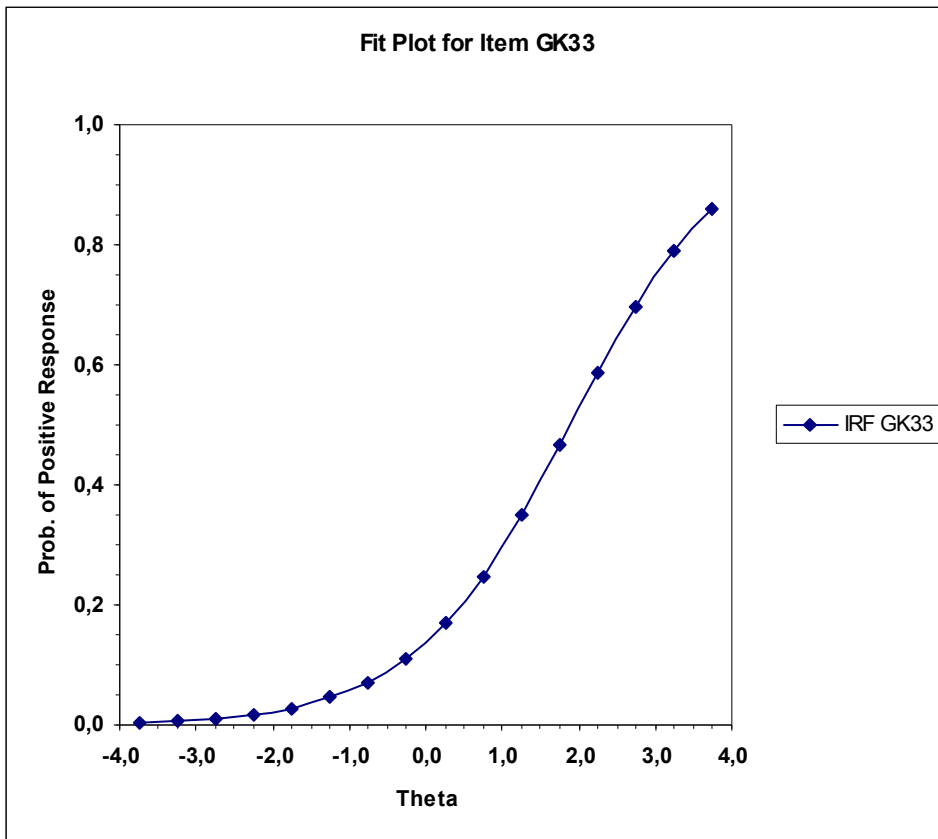


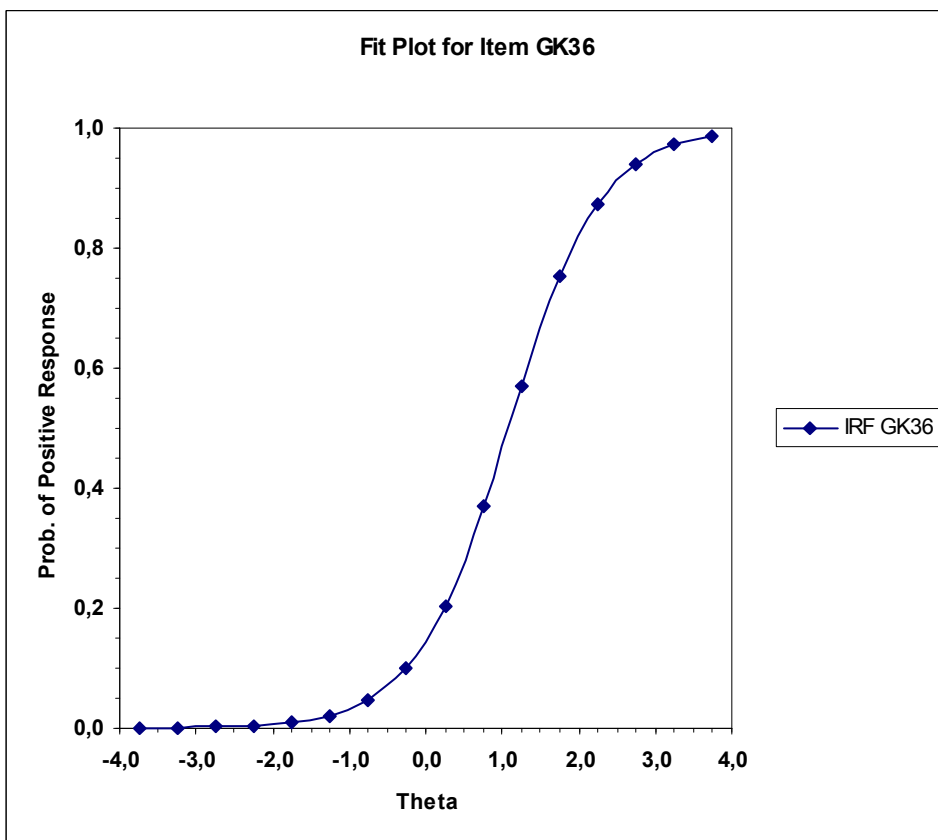
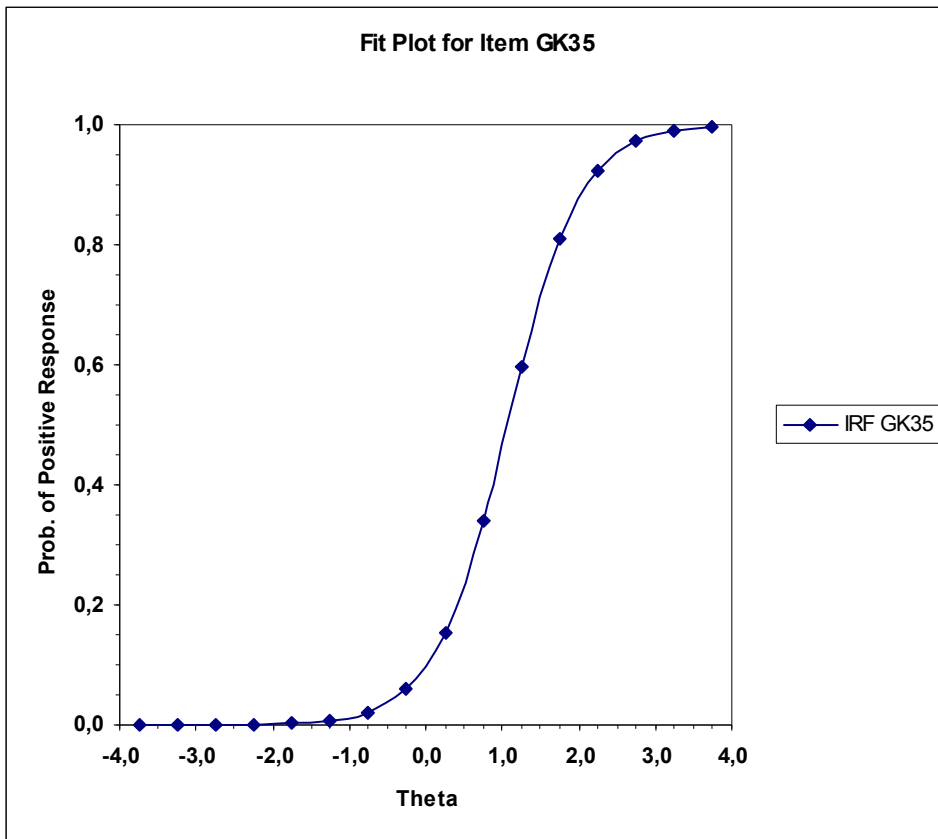


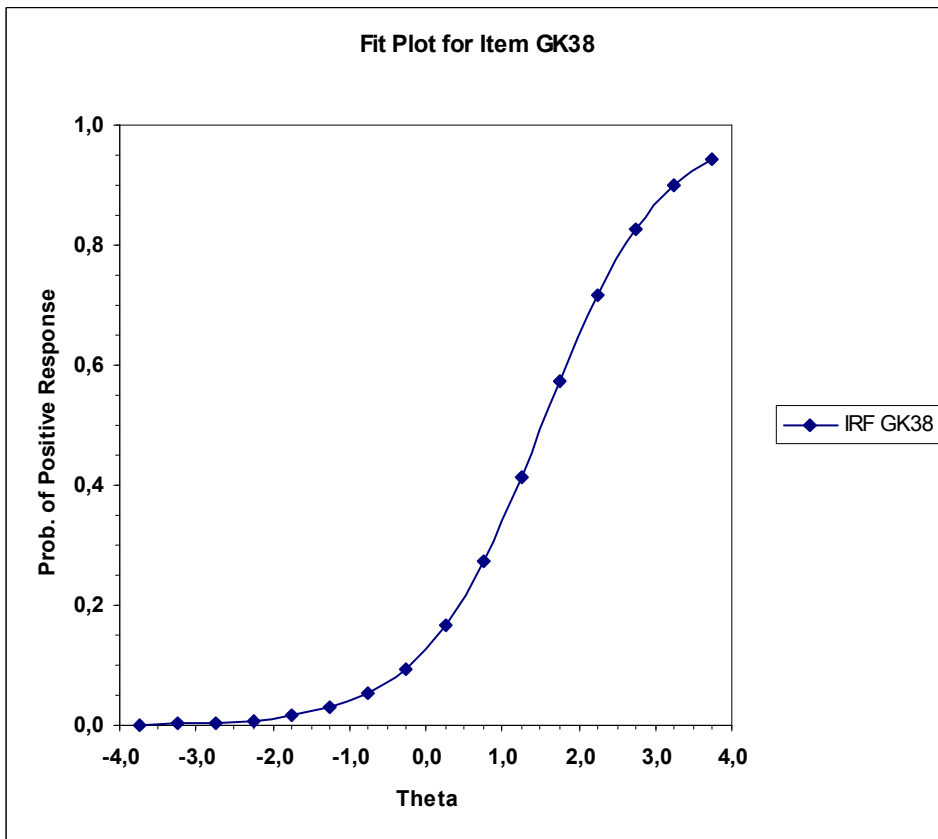
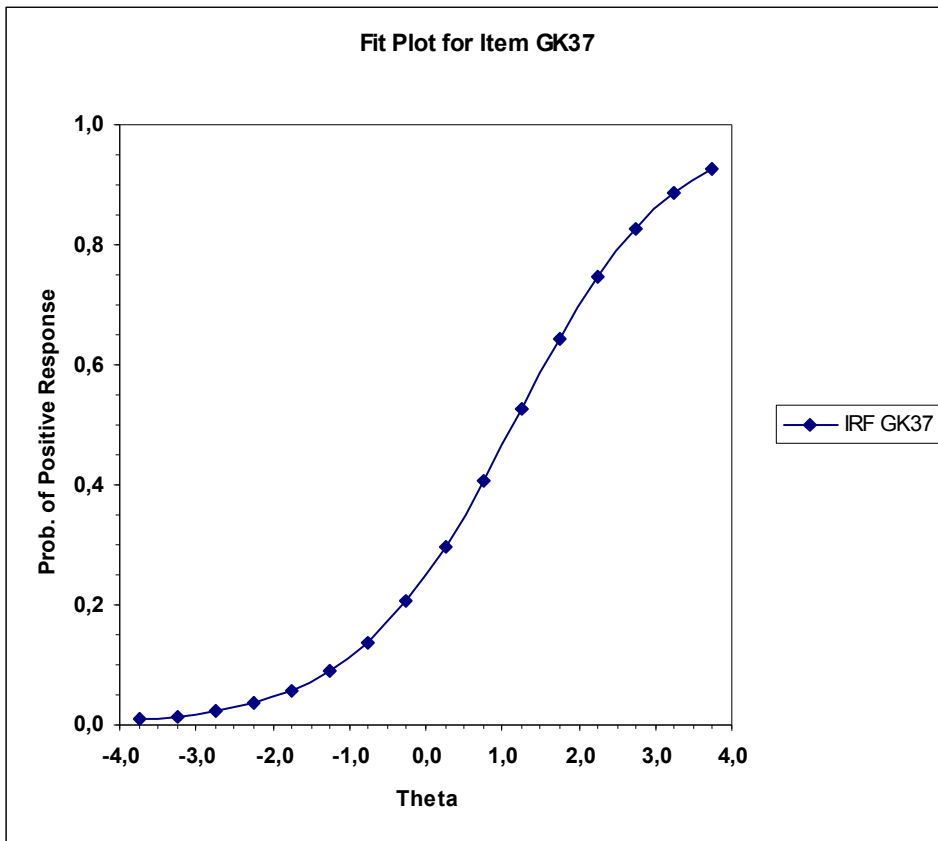


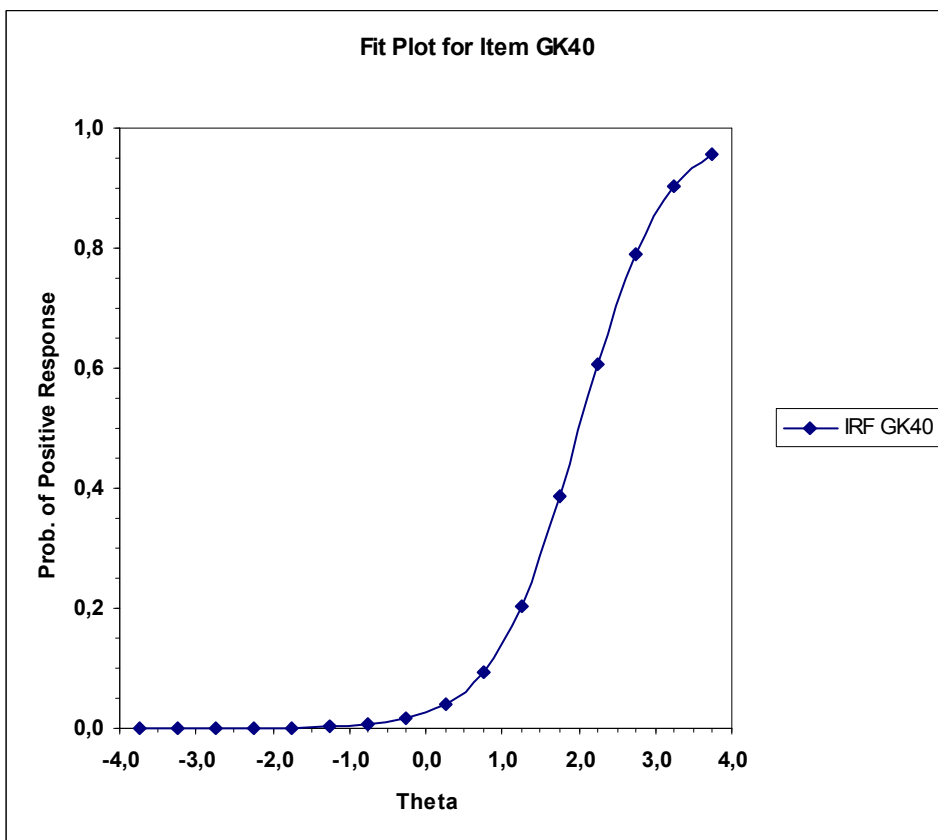
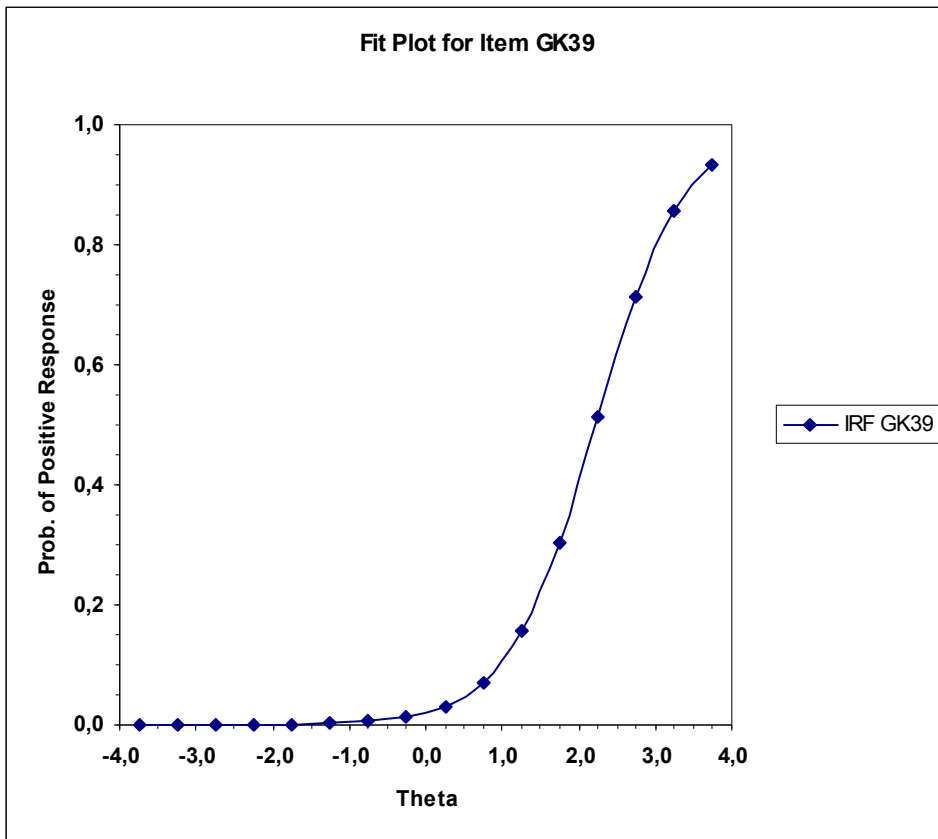


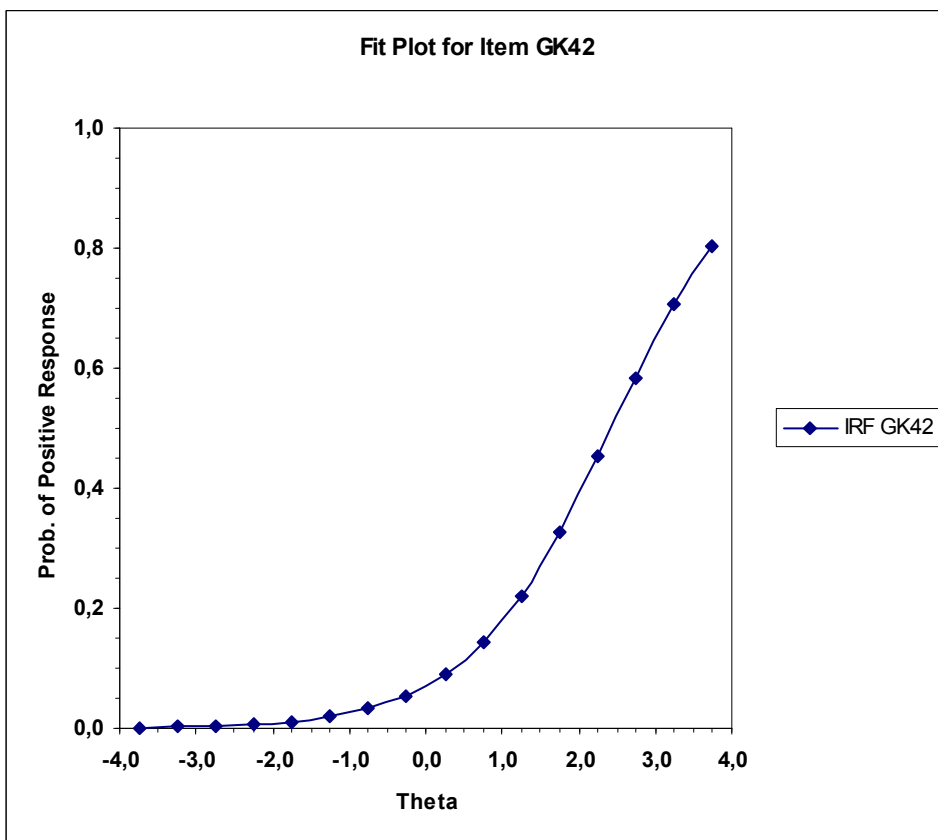
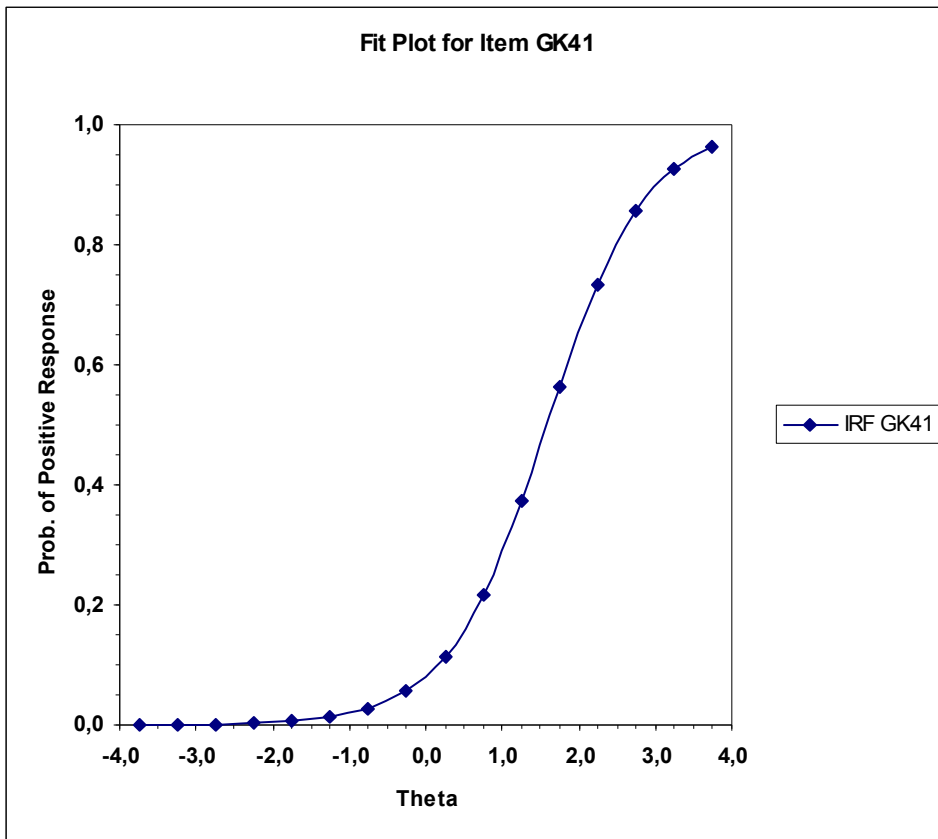


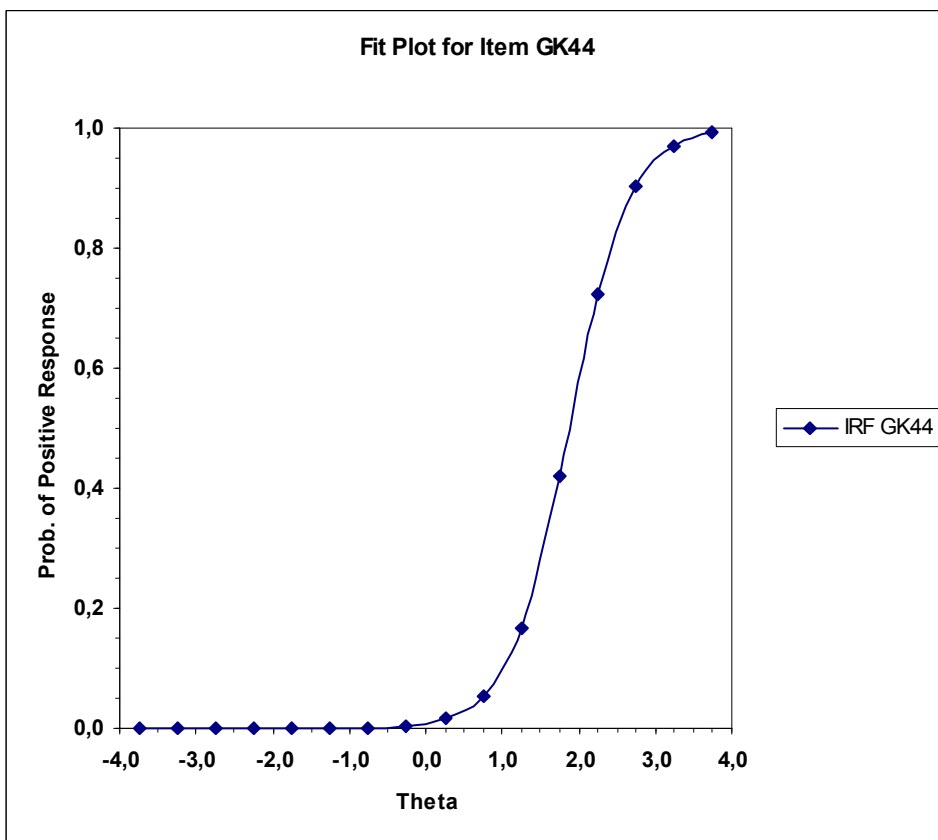
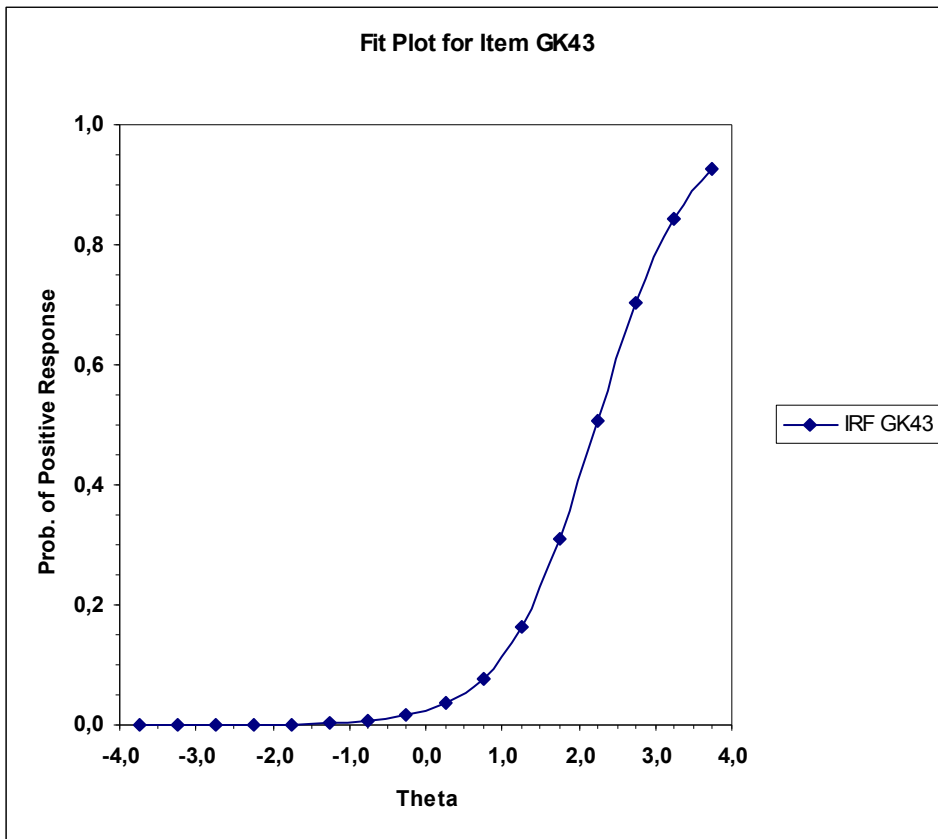


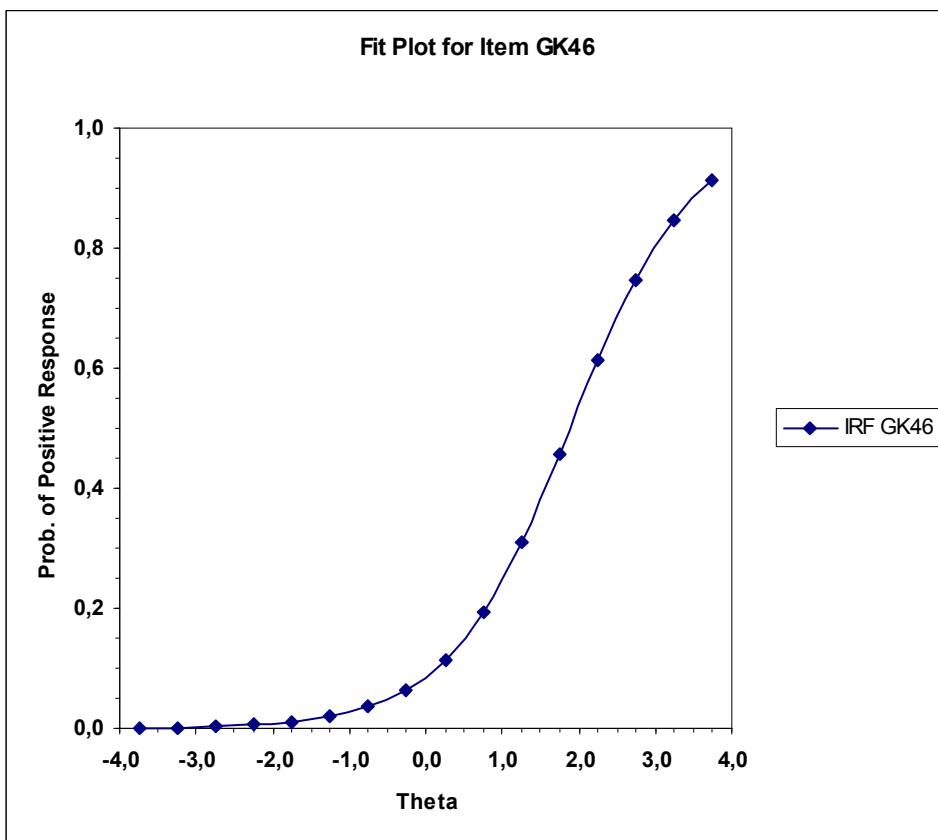
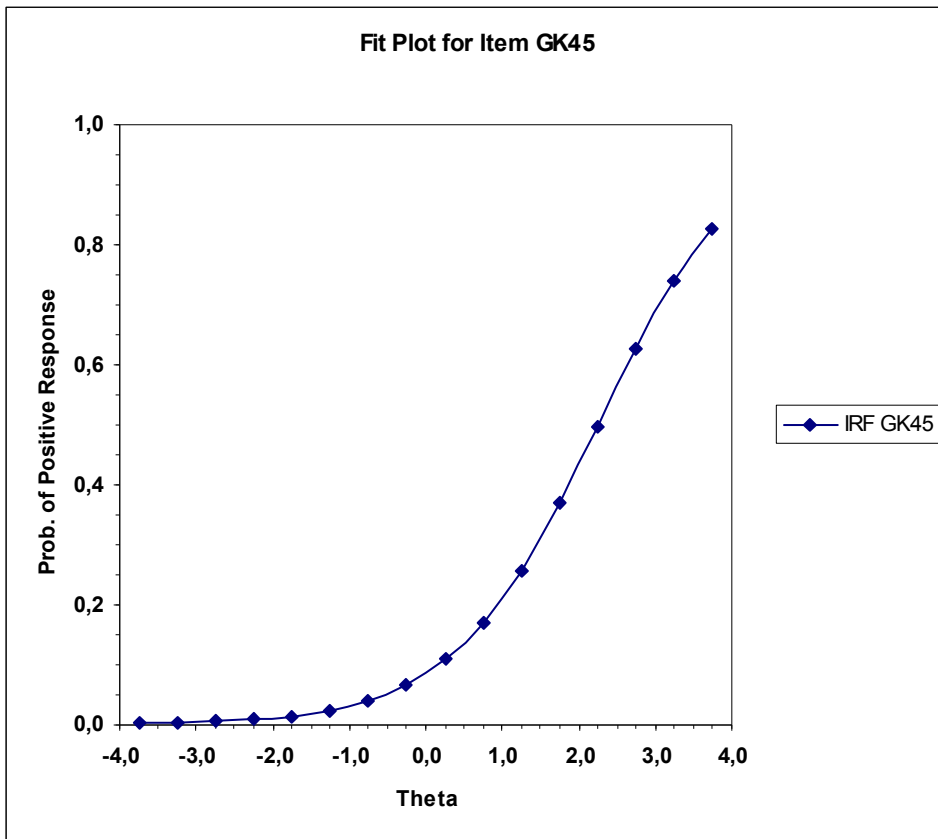


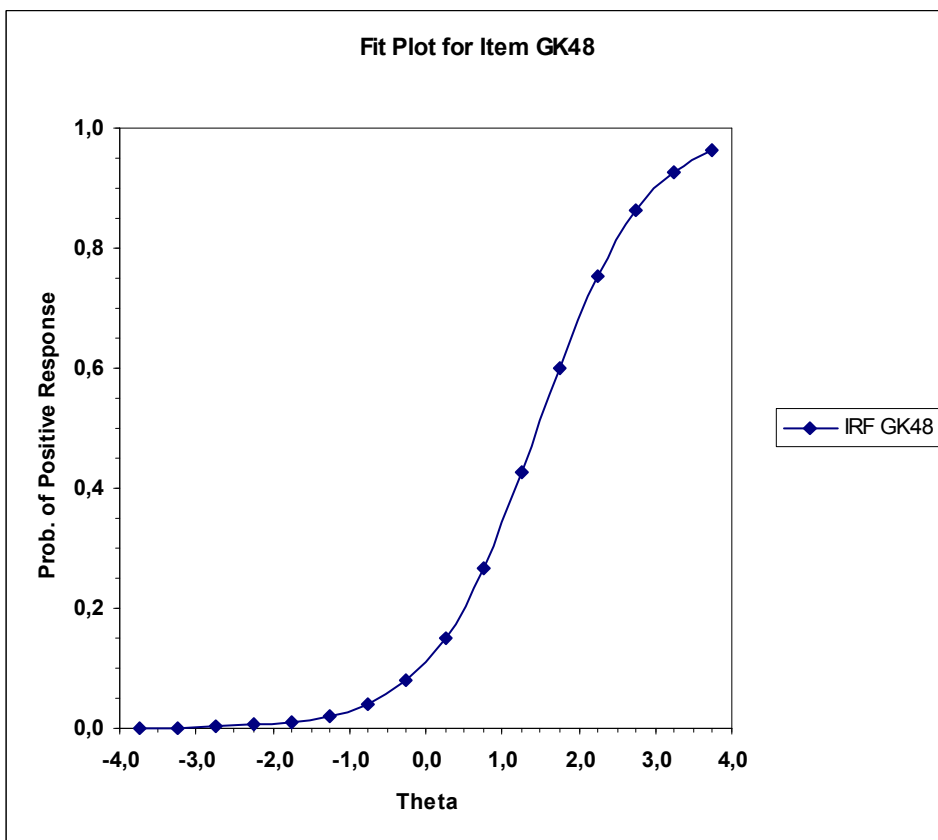
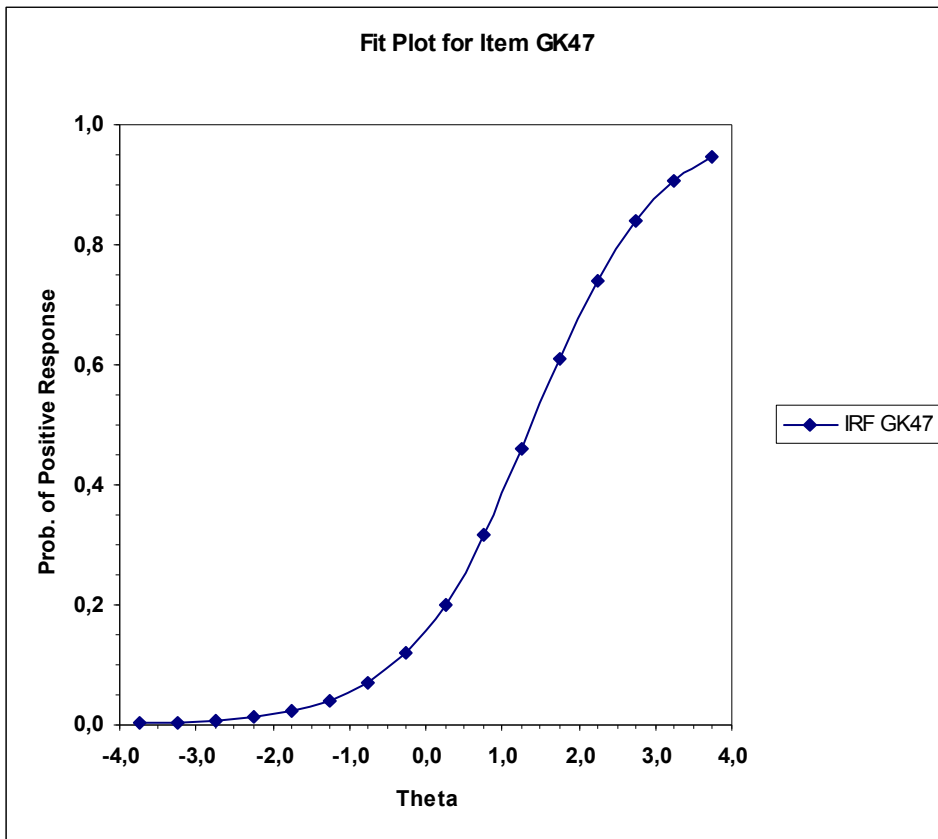


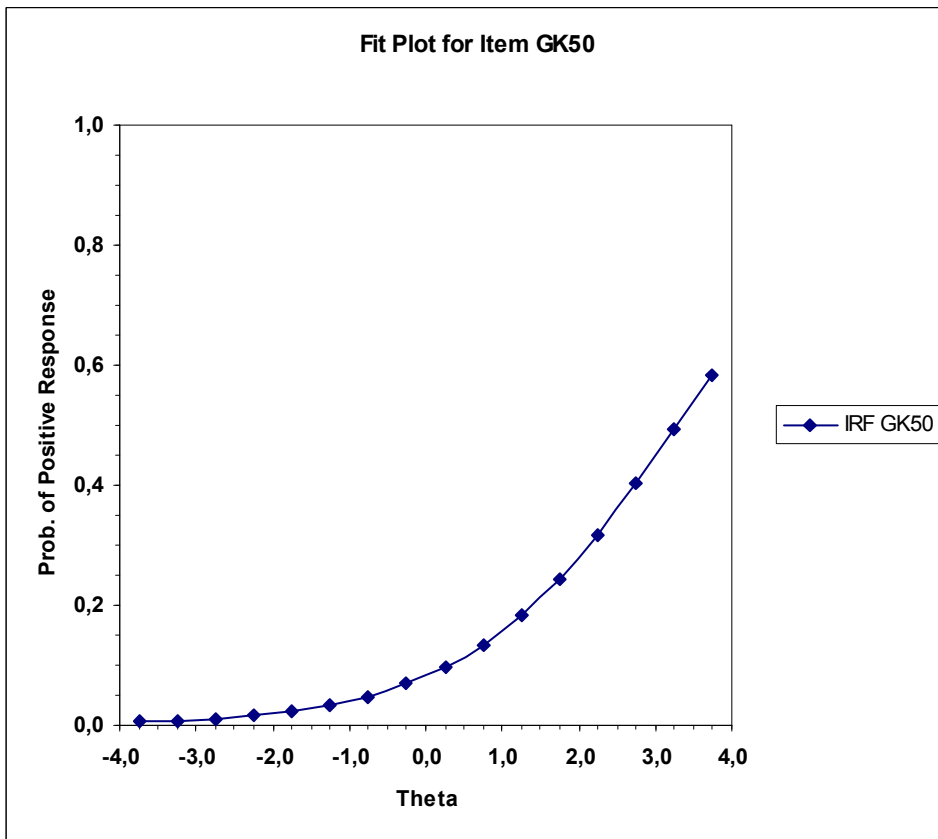
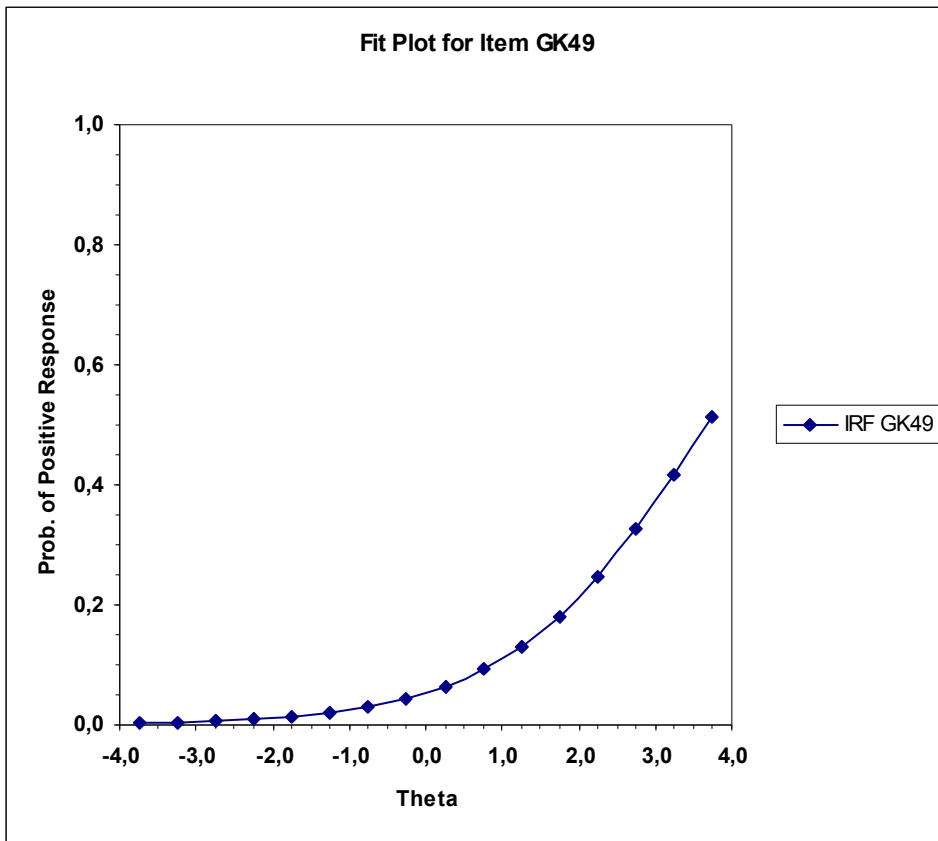


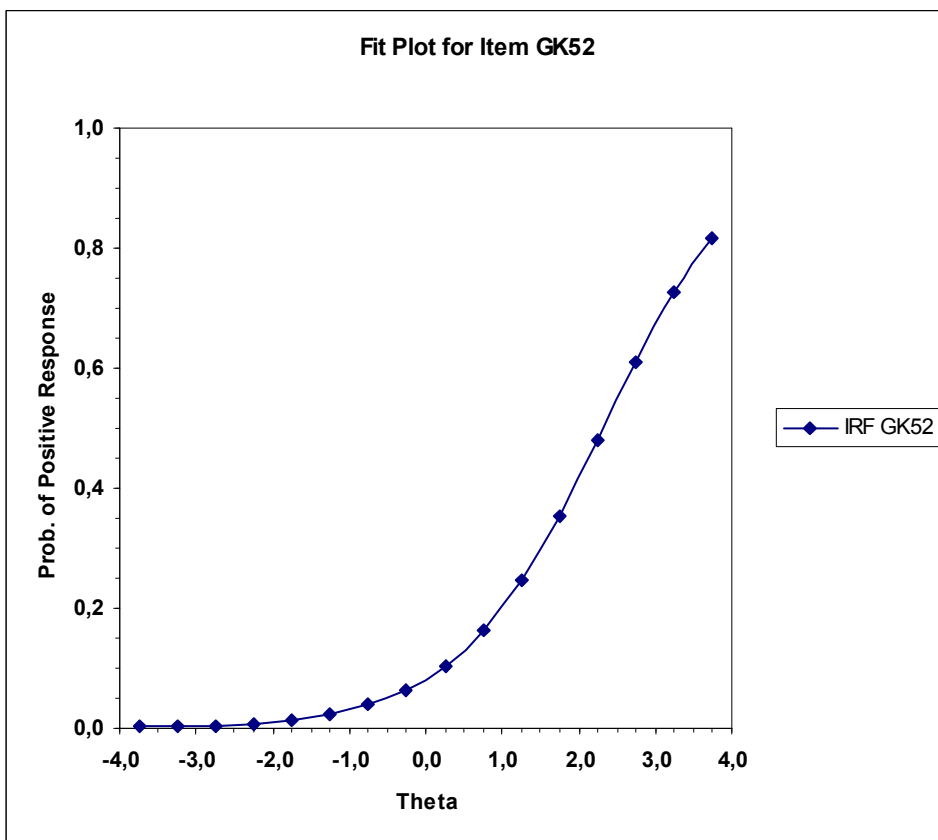
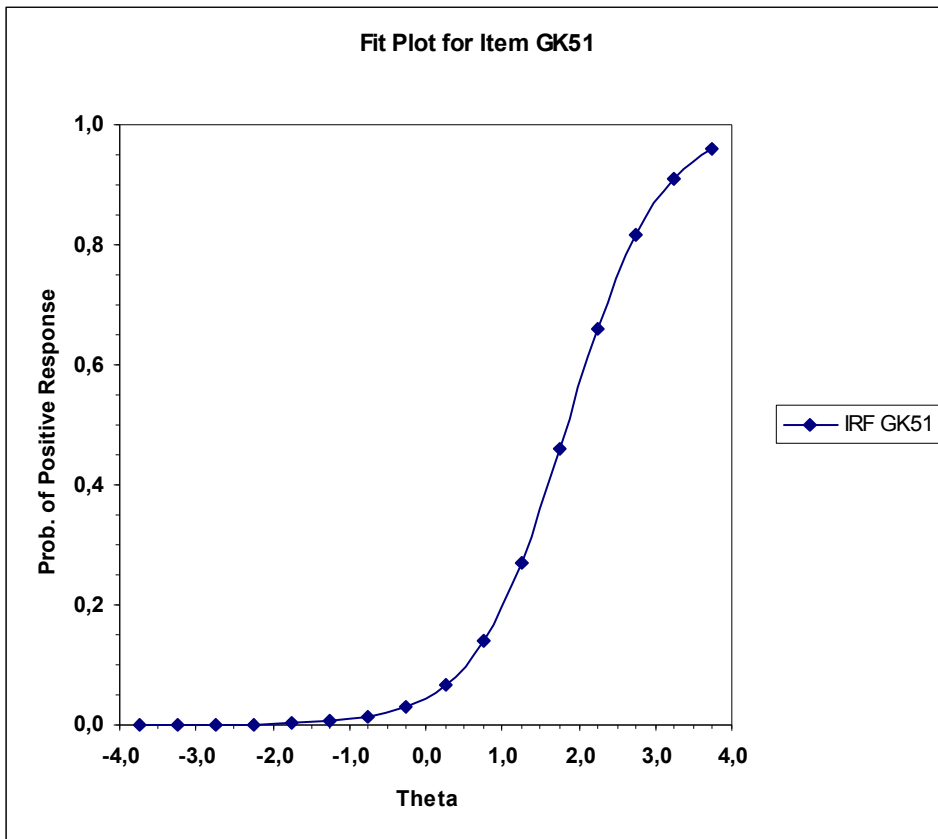


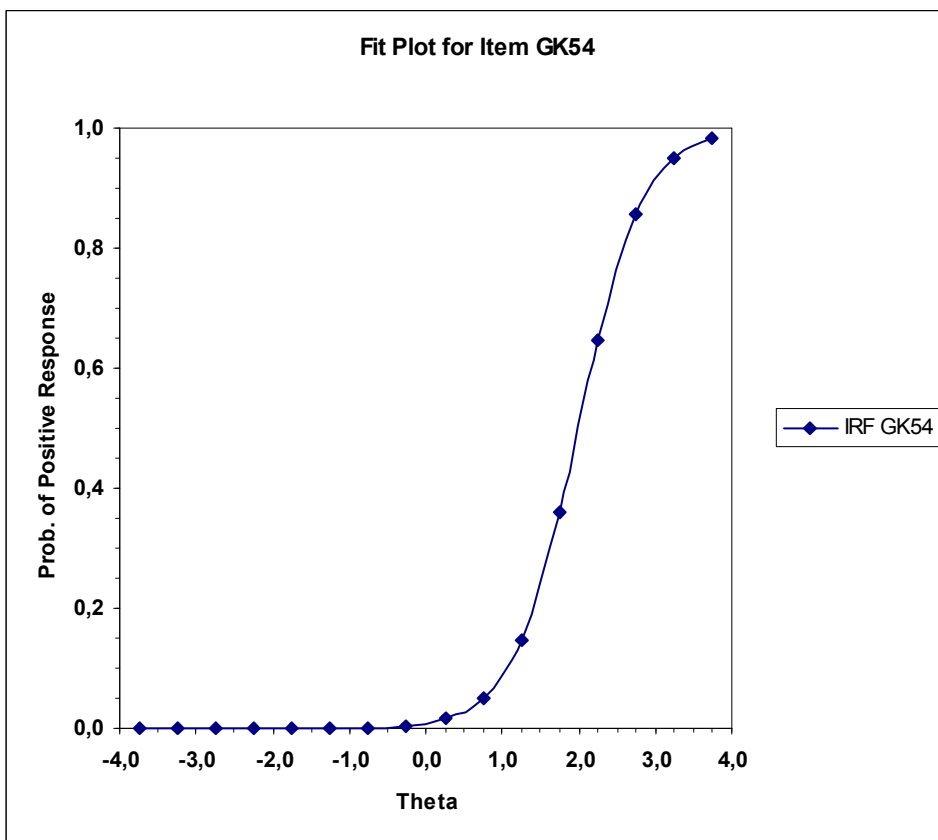
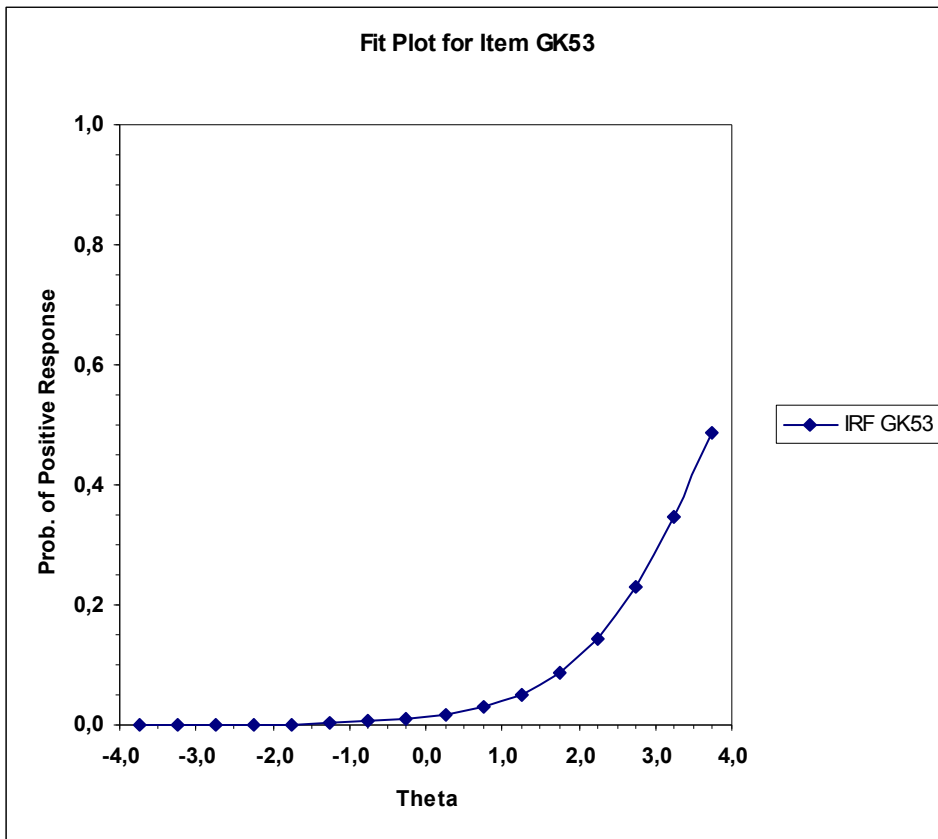


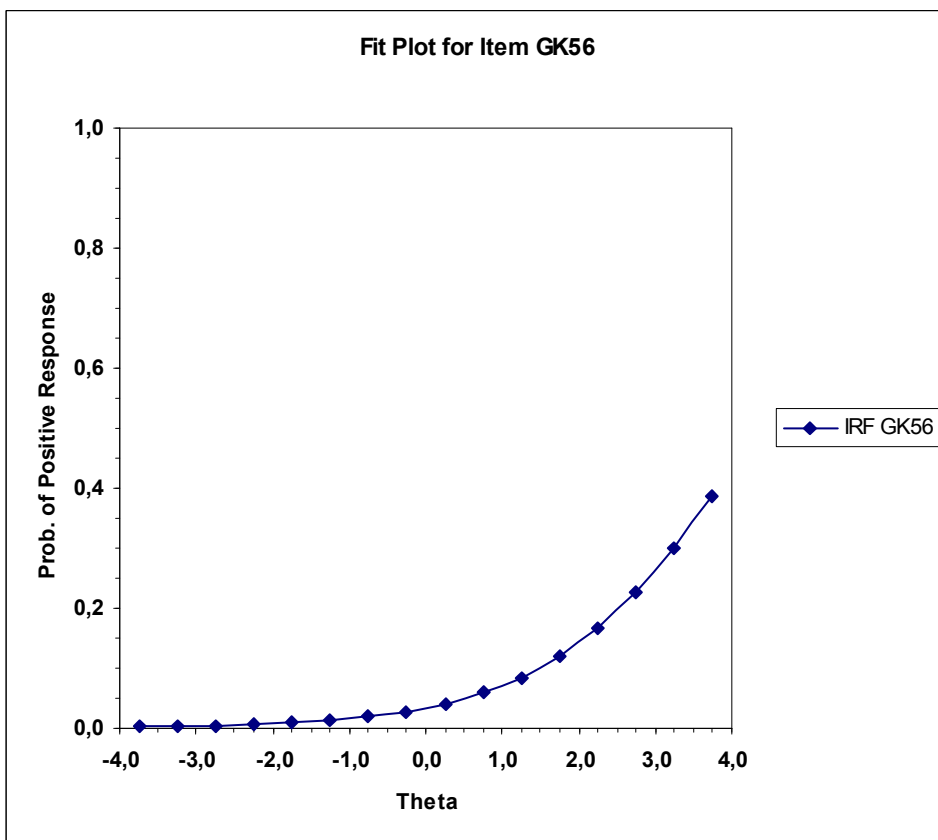
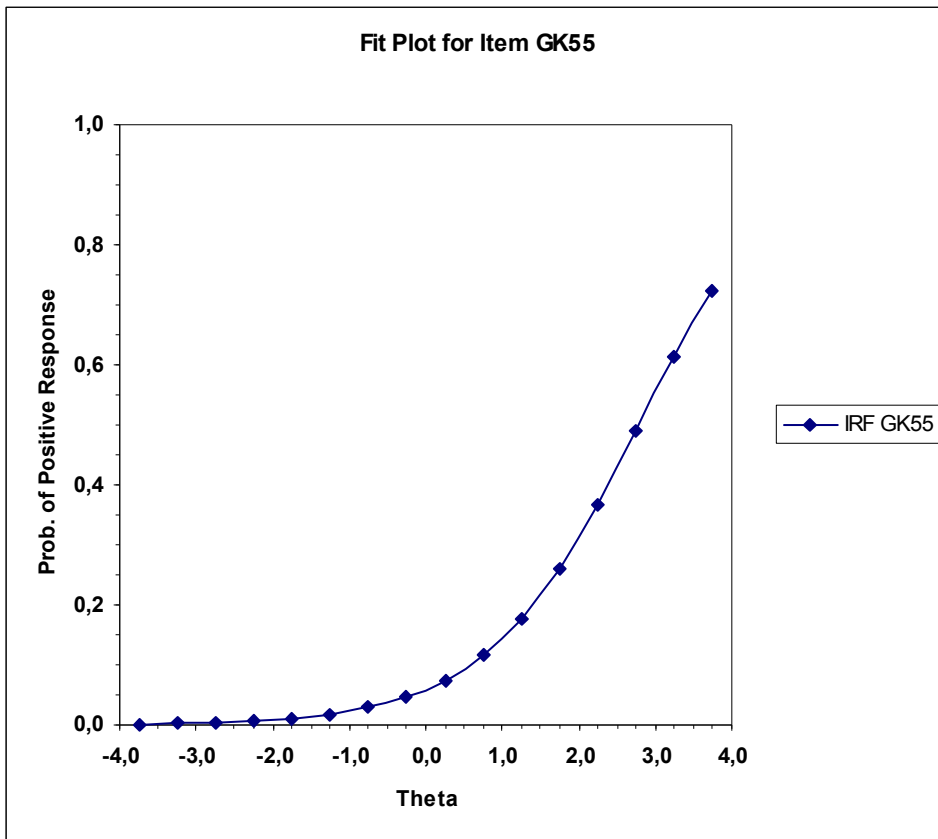












## Exploratory Factor Analyses

Factor analysis is a common method of examining the patterns of relationships among a set of variables and is a commonly recommended analytical approach in order to evaluate the presence and structure of any latent constructs among a set of variables such as subtests scores on a test battery (Cronbach, 1990; Kamphaus, 2001).

Two different factor analysis were applied, first with only the three intelligence subtests of the CCAT Crystallized-Educational Scale, and then with these three plus the two Verbal subtests of the Reynolds Intellectual Assessment Scales (RIAS; Reynolds & Kamphaus, 2003).

For exploring the presence of a general latent trait, the method of principal axis (factor) was chosen. Although the method known as principal components might have been justified on the basis of the high reliability of the subtests, this method begins with the assumption of perfect reliability, with a guessed communality of 1 for each variable. The principal axis method doesn't make such assumption beginning with  $r^2$  (the squared correlation of all the other subtest scores with the one being considered) in the diagonal and then estimating the communality of each variable through an iterative process until  $h^2$  (the maximal communality estimate) is reached. That estimate is then placed into the diagonal of the matrice for the final factor extraction. In such analyses the first unrotated factor to be extracted is commonly interpretate as *g*. The correlations of each subtest with this factor, in other words, the factor loadings, are indicators of the degree to which each subtest measures general intelligence as opposed to more specific components of ability.

**Table 2 CCAT Crystallized-Educational Scale and RIAS Verbal Scale Subtest Loadings**

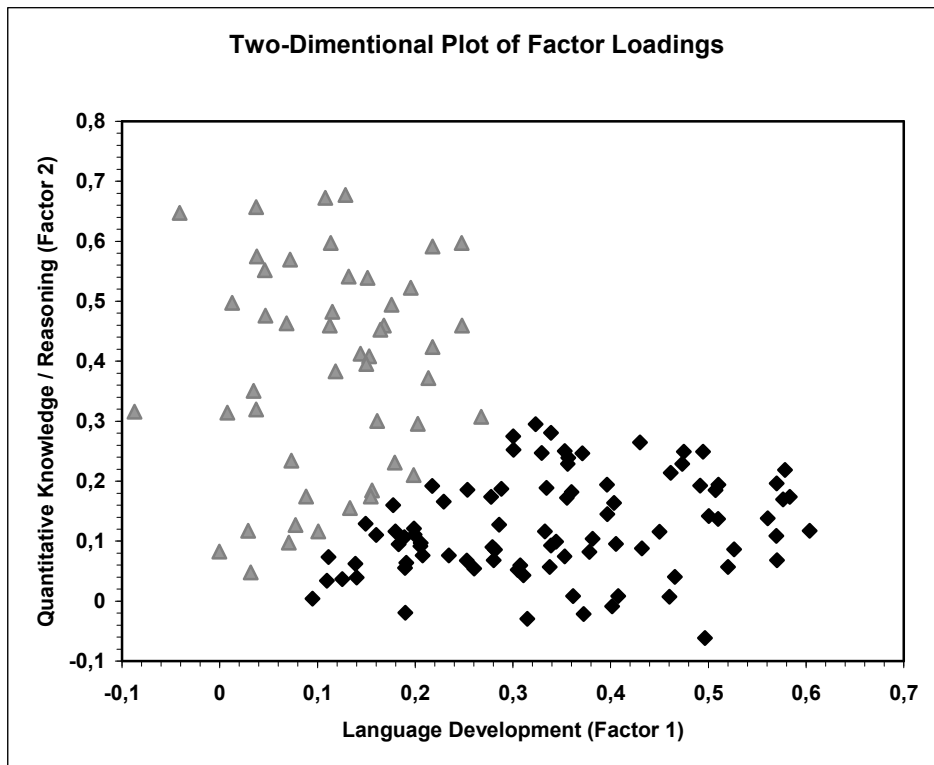
Subtest	Gc <sup>a</sup>	Factor 1	Factor 2
<b>Verbal Analogies</b>	.84	<b>.88</b>	.28
<b>Math. Problems</b>	.61	.28	<b>.96</b>
<b>General Knowledge</b>	.83	<b>.90</b>	.24
<i>N</i> =304			
<b>Verbal Analogies</b>	.79	<b>.78</b>	.37
<b>Math. Problems</b>	.54	.27	<b>.96</b>
<b>General Knowledge</b>	.85	<b>.86</b>	.27
<b>Guess What</b>	.90	<b>.92</b>	.19
<b>Verbal Reasoning</b>	.81	<b>.83</b>	.24
<i>N</i> =76			

*Note.* Values in bold indicate the highest loadings on the revealant factor.

<sup>a</sup> *Gc*, or general crystallized intelligence factor, reported as the subtests' loadings on the first unrotated principal factor from a principal axis solution. Loadings for both Factor 1 and Factor 2 are those following varimax rotation from a principal components solution.

As shown in Figure 1, two significant factors exist into the whole scale. The verbally-oriented items tend to have high ranking onto the x-axis while quantitatively-oriented items tend to be ranked high onto the y-axis.

Figure 1



Interestingly, few items from the Verbal Analogies subtest show a better loading on the second factor than on the first which gathers the verbally-oriented tasks. In fact, those items are prepared in such way that knowledge is not that required and reasoning is much more important. We can imagine those analogies to be closely linked with one part of what the second factor is made of: generally speaking, the second factor is a mixture of knowledge and reasoning. Thus, it is not surprising to find analogies with positive loading on a factor which involves reasoning application more than only verbal intellectual processes.

This discovery was also important to determine the nature of Factor 2. While the first factor has been easy to identify, evidence of the complexity of Factor 2 was shown by the loadings of reasoning tasks such as analogies.

## Criterion-Related-Validity

As expected, the CCAT Crystallized-Educational Scale very highly correlates with other measures of crystallized related aptitudes such as the verbal part of the Reynolds Intellectual Assessment Scales (RIAS; Reynolds & Kamphaus, 2003), the American College Testing program (ACT) and the 1995-2005 version of the Scholastic Aptitude Test (SAT). It also shows high correlation with the non-verbal figurative IQ of the General Ability Measure for Adults (GAMA; Naglieri & Bardos, 1997).

Test	Verbal Analogies	Math. Problems	General Knowledge	Verbal Scale	Crystallized-Edu. Scale
<b>ACT, Comp.</b> (N=28)	.67	.67	.79	.82	.84
<b>GAMA, IQ</b> (N=49)	.53	.66	.48	.52	.62
<b>RIAS, VIX</b> (N=76)	.81	.60	.83	.86	.85
<b>RIAS, GWH</b> (N=76)	.81	.53	.82	.85	.82
<b>RIAS, VRZ</b> (N=76)	.76	.64	.80	.82	.82
<b>SAT I</b> (N=34)	.48	.79	.70	.69	.79
<b>SAT I, Math.</b> (N=34)	.34	.71	.41	.43	.62
<b>SAT I, Verb.</b> (N=34)	.45	.58	.81	.77	.76
<b>SAT</b> (N=42)	.20	.35	.52	.45	.49
<b>WAIS-III, FSIQ</b> (N=10)	.75	.76	.81	.81	.95

*Note.* Correlations are corrected for restriction of range (McNemar, 1949).

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