Cerebrals Society International Contest 2009

2-Parameters Logistic Model

Item Characteristic Curves

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The data collected from the first 243 subjects has been used in order to analyse the psychometric validity of each item. The first assumption that has been made is to draw the Item Characteristic Curves (ICC) using the 2-Parameters Logistic Model (2PLM) as developed by Birnbaum (1968). The first parameter is the discrimination parameter referred to with letter \( a \), which is proportional to the slope of the ICC at the ability scale point \( b \), the second parameter, also called the difficulty parameter. This model is the generalization of the 1-Parameter Logistic Model (1PLM) firstly introduced by Rasch (1960), which only takes into account the item difficulty as given by the \( b \)-parameter. There also exists a model that includes a third parameter for guessing, called \( c \)-parameter. However, according to Hambleton, Swaminathan, & Jane Rogers (1991) this 3-Parameters Logistic Model (3PLM) is only applicable for multiple-choice items, because on free-response items like those of the Contest, the assumption of no guessing is quite probable and thus the model does not require the \( c \)-parameter.

The ICC for each of the Contest’s hundred items relatively to their respective subtest, are all shown in Figures 1 to 100. These curves are the Item Response Functions (IRF) and could eventually be used in order select, discard or revised questions with unsatisfactory properties. Test items must be those with steeper slopes because they are more useful to separate the subjects into different ability levels. This results in a high \( a \)-parameter value.

The parameters have been estimated with NOHARM (Fraser & McDonald, 1988). This Item Response Theory (IRT) parameter estimation uses the Least Squares procedure to estimate parameters. The theta (\( \theta \)) scale that represents ability was sectioned into sixteen equally spaced intervals of .5, ranging from -4 to 4. The midpoints of each interval were -3.75, -3.25, -2.75, -2.25, -1.75, -1.25, -1.25, -2.25, -0.75, -0.25, -0.75, 1.25, 1.75, 2.25, 2.75, 3.25 and 3.75.
Figure 1 - Fit Plot for Item 1
Figure 2 - Fit Plot for Item 2
Figure 3 - Fit Plot for Item 3
Figure 4 - Fit Plot for Item 4
Figure 5 - Fit Plot for Item 5
Figure 7 - Fit Plot for Item 7
Figure 8 - Fit Plot for Item 8
Figure 9 - Fit Plot for Item 9
Figure 10 - Fit Plot for Item 10
Figure 11 - Fit Plot for Item 11
Figure 12 - Fit Plot for Item 12
Figure 13 - Fit Plot for Item 13
Figure 14 - Fit Plot for Item 14
Figure 15 - Fit Plot for Item 15
Figure 16 - Fit Plot for Item 16

![Plot](image.png)
Figure 17 - Fit Plot for Item 17
Figure 18 - Fit Plot for Item 18
Figure 19 - Fit Plot for Item 19
Figure 20 - Fit Plot for Item 20
Figure 21 - Fit Plot for Item 21
Figure 22 - Fit Plot for Item 22
Figure 23 - Fit Plot for Item 23
Figure 24 - Fit Plot for Item 24
Figure 25 - Fit Plot for Item 25
Figure 26 - Fit Plot for Item 26
Figure 27 - Fit Plot for Item 27
Figure 28 - Fit Plot for Item 28

$P(\theta)$ vs $\theta$ for IRF WN28.
Figure 29 - Fit Plot for Item 29
Figure 30 - Fit Plot for Item 30
Figure 31 - Fit Plot for Item 31
Figure 32 - Fit Plot for Item 32

$P(\theta)$ versus $\theta$.

IRF WN32
Figure 33 - Fit Plot for Item 33

\[ P(\theta) \]

\[ \theta \]

IRF WN33
Figure 35 - Fit Plot for Item 35
Figure 36 - Fit Plot for Item 36
Figure 37 - Fit Plot for Item 37
Figure 38 - Fit Plot for Item 38

$P(\theta)$

IRF WN38
Figure 39 - Fit Plot for Item 39
Figure 40 - Fit Plot for Item 40
Figure 41 - Fit Plot for Item 41
Figure 42 - Fit Plot for Item 42

\[ P(\theta) \]
Figure 44 - Fit Plot for Item 44
Figure 45 - Fit Plot for Item 45
Figure 46 - Fit Plot for Item 46
Figure 47 - Fit Plot for Item 47
Figure 48 - Fit Plot for Item 48
Figure 49 - Fit Plot for Item 49

The plot shows the relationship between $P(\theta)$ and $\theta$. The curve increases sharply as $\theta$ increases, indicating a strong positive relationship. The label IRF WN49 is used to denote the specific data set or condition represented by the plot.
Figure 50 - Fit Plot for Item 50
Figure 51 - Fit Plot for Item 51
Figure 52 - Fit Plot for Item 52
Figure 53 - Fit Plot for Item 53
Figure 54 - Fit Plot for Item 54
Figure 55 - Fit Plot for Item 55
Figure 56 - Fit Plot for Item 56
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Figure 84 - Fit Plot for Item 84

$P(\theta)$ vs $\theta$ for IRF WW34.
Figure 85 - Fit Plot for Item 85
Figure 86 - Fit Plot for Item 86
Figure 87 - Fit Plot for Item 87
Figure 88 - Fit Plot for Item 88
Figure 89 - Fit Plot for Item 89
Figure 90 - Fit Plot for Item 90
Figure 91 - Fit Plot for Item 91
Figure 92 - Fit Plot for Item 92
Figure 93 - Fit Plot for Item 93

$P(\theta)$ vs $\theta$ with IRF WW43
Figure 94 - Fit Plot for Item 94
Figure 95 - Fit Plot for Item 95
Figure 96 - Fit Plot for Item 96
Figure 97 - Fit Plot for Item 97
Figure 98 - Fit Plot for Item 98
Figure 99 - Fit Plot for Item 99
Figure 100 - Fit Plot for Item 100
From this 2PLM analysis vocabulary questions number 2, 4 and 7 appear to be inappropriate for the expected use.
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