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Overview

IPLINK is a program to find the linking parameters for two given item parameter files (focus and reference groups). The objective is to minimize the criterion functions with respect to the linking parameters. IPLINK can handle various types of parameterization of the item characteristic function. There are currently three types of criterion functions to choose from in IPLINK: the direct method, the TCF method and the ICF method. For more details, see Model Selection.

This online help is organized in two sections: Usage and technical details.

Any question and/or comment are welcome to improve this program. The most frequent asked question seems to be about the setting of data file format, please e-mail a sample data file to the author if you have the problem.

For any comments or questions, please contact the authors at

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Getting Started

First, two item parameter files are needed to calculate the linking coefficients. Then the initial parameter concerning the calculation needs to be set. This can be accomplished in two ways. The first one is to load a previously saved initial parameter file by choosing the menu item File|Load Linking Ini. The second is to compose a new initial parameter set by choosing the menu item File|New Linking Ini. For more information about the linking initial parameter dialog, see the [linking dialog](#) of this help file.

To run the linking program after choosing the correct initial parameter setting, click the Link button in the initial parameter dialog or the menu item Run|Linking.

Besides the linking, this program contains some editing functions like copy, paste, clear, view and print file such that information can be exchanged with other Window programs.

Run Sample File

Choose menu File|Load Linking ini, pick the file Mdini.ini. Then click the "Link" button in the [linking dialog](#) window.

Main Menu and Toolbar

Since IPLINK is built on top of a notepad equivalent program, most menu items should be familiar to users. Here only the linking related menu items are described.

Menu

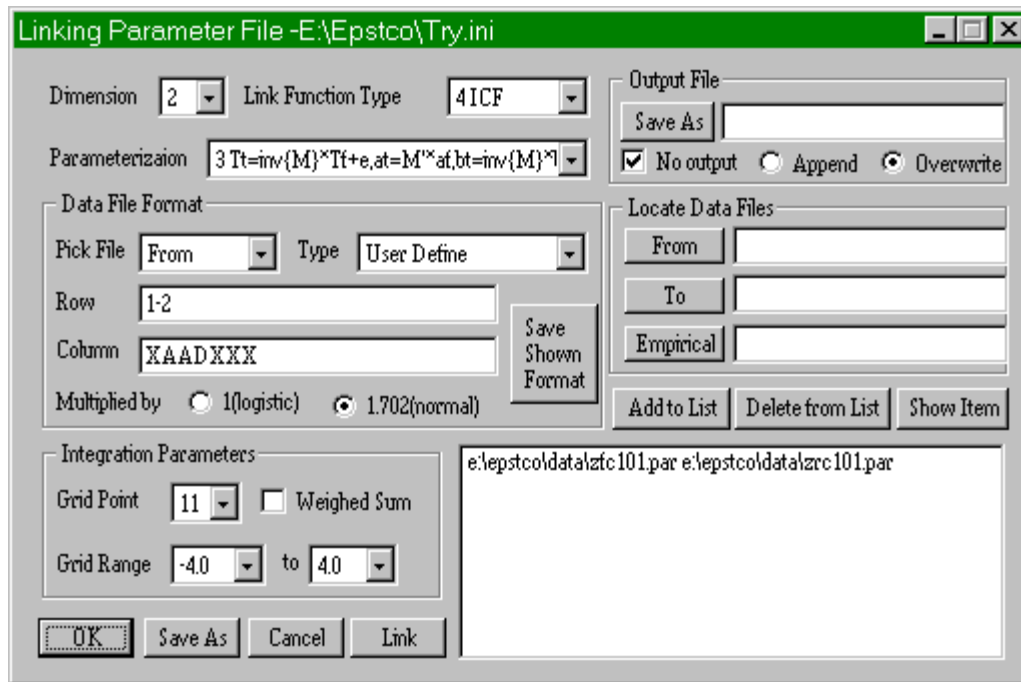
- File|New Linking Ini. Open the linking initial parameter dialog to compose a new initial parameter file.
- File|Load Linking Ini. Load existing linking initial parameter file and open the linking initial parameter dialog for editing and linking.
- Run|Linking. Run linking using existing linking initial parameter file.
- Run|Iterative Linking. Run iterative linking using existing existing linking initial parameter file.

Toolbars

 (from left to right, in groups)

- Open new text file; Open existing text file; Save text file
- Cut; Copy; Paste; Print text file; Help(content)
- Load existing linking initial file; Run linking with existing initial file

Linking Dialog Window



This dialog is used to set linking initial parameter and make linking. The setting is divided into several groups:

- **General Setting**
- **Data File Format**
- **Intergration Parameters**
- **Locate Data Files**

File Format

Input File Format

Column format

It requires every row to be read in the item parameter file is identical in terms of column format. For instance, if there are total 7 columns in each row and the 3rd column is the first element of a, 4th column is the second element of a, 6th column is d, 7th column is c, then the column format should be XXAAXDC. X means the read but unused column. Acceptable choices are X, A, B, C and D. All other will be treated as X.

For empirical theta files, the format is similarly something like XXTTXXX where T represents elements of theta and X is the unused column.

Row format

As for row selection, only unread rows need to be identified and empty row does not count. For instance, if rows 1, 3, 5 to 10 are to be skipped, the row skip format is {1,3,5-10}. Also {4S5} means skipping row 4-8. {4S2R1}, on the other hand, means to, starting at row 4, skip 2 rows (row 4 & 5), then read 1 row (row 6), then repeat the exact reading pattern (from row 7) till the end. A combination in any order, like {1,3-5,5S2, 8S1R3, 78-90}, is acceptable.

Output File Format

One example of the output file format is:

```
zfc101.par(1),zrc101.par(1),Ing:Grid[-4,4];W(0),T#:81,TD#:2,I#:40,M:1,P:2  
4.089532e-02 0.80724 0.068636 -0.056156 0.839592 0.113839 -0.262078
```

```
*****
```

Meaning of each line above:

1. FROM file, TO file, (1) means 1.702 is multiplied to the exponent before the exponential function $L[]$ is calculated; (0) means no such multiplication. Ing is the integration method, either grid method with the range or using empirical theta file (then the file name is given instead of the range [-4,4]). W(1) means using weighed sum in the integration approximation; W(0) means unweighed sum is used. T# is the number of theta used in integral approximation. TD# is the dimension of theta. I# is the total item number. M: is the model specification, P: is the parameterization specification.
2. From left to right: The mean sum of squares of residuals; the elements of M (rowwise), the elements of e.
3. (*****) Not meaningful, used to separate each round of calculation.

For each calculation, you have the options to either append the outcome to an existing file or write the outcome to a new file. And if you empty the output file frame in the data file source window, the outcome is presented in the program window only.

Model Selection

The model selections indicate which function to be minimized to find the linking parameters. The available options are

1. Direct method

The sum of squares of the differences between the corresponding elements of a and a_1 , b and b_1 , d and d_1 , respectively. The minimization procedure is basically a multivariate linear regression procedure.

2. Reserved for future use.

3. TCF (Test Characteristic Function) method

The sum of squares of the differences between the test scores of the same examinee in the two groups. The minimization method is a modified Newton method, with or without using the second-derivative.

4. ICF (Item Characteristic Function) method

The sum of squares of the differences between item probabilities for each item and each examinee. The minimization procedure is the same as in the TCF method.

Integral Approximation

In the TCF and ICF methods, the differences are smoothed over the domain of theta by means of integral. There are two options in IPLINK to approximate the integrals.

1. **Grid method**

In this method an k dimension (with k being the dimension of theta) is chosen as the region of integral approximation. The one-dimensional length of the grid is determined by the beginning and the ending parameters. The number of equally spaced grid points (theta points) is decided by the grid point parameter.

2. **Empirical theta method**

Instead of using equally spaced grid points, users can also provide empirical (examinee) theta file as theta values to be used in the approximation.

In both methods, users have the option to use unweighed or *weighed sum* when calculating the approximation. In the latter case, the standard normal density function (for given grid or empirical theta point) is used as the weight function.

Parameterization

The item success probability function has the following general form:

$$P() = c + (1 - c)L[]$$

where $L[]$ is either the logistic or normal distribution function.

Using the conventional notations, we list the specifications of parameterizations and linking as follows. $a(1)$, $\theta(1)$, and $b(1)$ are the k dimension vectors with k being the ability dimension. $d(1)$ is a scale number used in parameterization 2 and 4 below. The notation with and without the (1) represents item parameters from two different groups being linked. M ($k \times k$ dimension) and e ($k \times 1$) are the linking parameters. Four kinds of parameterization and their corresponding linking methods are presented below.

Parameterization	Linking
1 $L[a'(\theta-b)]$	$\theta_1 = M^* \theta + e$, $a_1 = \text{inv}\{M\}'a$, $b_1 = M^*b + e$
2 $L[a'\theta + d]$	$\theta_1 = \text{inv}\{M\}\theta + e$, $a_1 = M'a$, $d_1 = d - a'M^*e$
3 $L[a'(\theta-b)]$	$\theta_1 = \text{inv}\{M\}\theta + e$, $a_1 = M'a$, $b_1 = \text{inv}\{M\}b + e$
4 $L[a'\theta + d]$	$\theta_1 = M^* \theta + e$, $a_1 = \text{inv}\{M\}'a$, $d_1 = d - a'\text{inv}\{M\}e$

For example, case #1 is assumed in a unidimensional linking program such as EQUATE although different notations are used there. For the output from a multidimensional IRT calibration program such as NORARM, #2 or #4 are used. Other setups can be transferred to one of the above.

Important note: different parameterization yields different solutions.