RASCH-GZ: The 1st Chinese Version of RASCH-Based Item Analysis and Test Equating System (Part I)

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1. RESEARCH BACKGROUND

It is known to all, since the last century, of all the objective measurement methods, researchers and practitioners have been using various software systems based on the Rasch model, such as: WINSTEPS, FACET, etc., because the Rasch model is the most versatile, powerful, and the most feasible!

In China, GITEST system can be deemed as one of such powerful and feasible software members. GITEST was originally developed as early as in 1980's under the guidance of the late famous Chinese linguist Prof. Gui Shichun (1933-2017). The system was programmed in BASIC, running under DOS processing data matrix of (200 items X 10,000 candidates, the maximum). From the viewpoint of Rasch professionals, GITEST is typically Rasch model-based item analysis and test equating system. It is worth mentioning that it is GITEST that was used to conduct the ten-year (1990-1999) equating project of Matriculation English Test (MET) sponsored by the National Education Examination Authority (NEEA) under Ministry of Education, China. MET is the most influential from a professional point of view; therefore, in this sense, GITEST has played a pivotal role in MET equating and has made a solid foundation for the standardized tests to be successfully implemented in China.

With the advent of the Internet era and the sustained improvement of computer technology and application requirements, the existing GITEST version can no longer meet the current needs. This is the motivation for us to comprehensively update and upgrade the GITEST system to RASCH-GZ[1] during the global fight against the COVID-19.

Technically, RASCH-GZ focuses on two main functions of language testing: item analysis and test equating. This chapter introduces the item analysis part of RASCH-GZ, and the application of test equating will be introduced in the next issue.

2. COMPARISON OF GITEST AND RASCH-GZ

The comparison between the fully upgraded RASCH-GZ and the GITEST system is shown in Table 1 below.

Table1. *Comparison of GITEST and RASCH-GZ*

GITEST	RASCH-GZ
BASIC，DOS	**(java, python, html, delphi) online**
Data Matrix： 200 items by X 10,000 subjects (Maximum)	**Compatible with Excel:** **Unlimited items by unlimited subjects**
Key operating	**Menu operating**
Results in English，text file	**Results in both English and Chinese, WORD file**
Not applicable	**Plotting**
Not applicable	**Online technical support**

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[1]http://www.rasch-gz.com

3. ITEM ANALYSES

Rasch-GZ has two important functions: item analyses and test equating. Item analyses are based on classical test theory (CTT). Rasch-GZ helps analyze each option of MC questions and generates a test report based on the following parameter. The present section deals with analyses, and test equating will be presented with data and discussion in the next issue.

Table2. *Item analysis based on CCT and idea interpretation*

Item analysis	Ideas and interpretations
Mean	the mean scores of the whole examinees;
SD	the standard deviations of the whole examinees;
Varn	the variants based on the whole examinees;
P+	probability of correct answers;
Pd，	Δ value, difficulty parameter based on probability;
R11	by Kuder-Richardson20，reliability, this value should be over 0.9
aVALUE	reliability parameter, also called α value, by Cronbach formula, this value should be over 0.8
Rbis	discrimination index (in the unit of bi-serial)
Skewness	score distribution value, 0 indicating normal distribution; above 0, indicating positive skewness, showing the test items more difficult； below 0, indicating negative skewness, showing the test items easier；
Kurtosis	score distribution height: 0 indicating normal; above 0 showing "narrower"，i.e. small range between the scores; below 0, indicating "flat", i.e. big range between the scores;
Difficulty	VD (<0.1), D (=0.1~0.3), I (0.3~0.7), E (0.7~0.9), VE (>0.9) VD: Very difficult； D: Difficult； I:Intermediate； E: Easy VE: Very easy

Item analysis provides feedback about each option of a MC question and generates an analysis report for the entire test paper based on the information above so that teachers and test item writers could use the information above to moderate/improve the quality of their test item production or to adjust the item difficulties, or decide whether or not to abandon some poorly designed test items.

4. BASIC OPERATION OF RASCH-GZ SYSTEM

This section guides users to learn to use RASCH-GZ with the simple and easy-to-understand language, diagrams and texts and avoids complicated technical terms. The basic operation of RASCH-GZ is divided into six parts. In what follows will be introduced three parts: (4.1) booting and system login, (4.2) data input; (4.3) item analyses and the evaluation report for a whole test paper.

4.1. System Login

First, click on the professional version program icon to start and run the RASCH-GZ system. The following login interface appears on your computer screen.

Figure4.1. *Login interface of Rasch-GZ*

System login is performed as follows:

(1) Enter the registered user name;

(2) Enter the password;

(3) If you need help, click the "Help button" to display a demonstration of the help;

(4) To exit the system, click the "Exit" button;

(5) Click the "Login" button to enter the system, and the following interface will pop up on the screen, namely: the data entry interface of Rasch-GZ as shown in Figure 4.2 below.
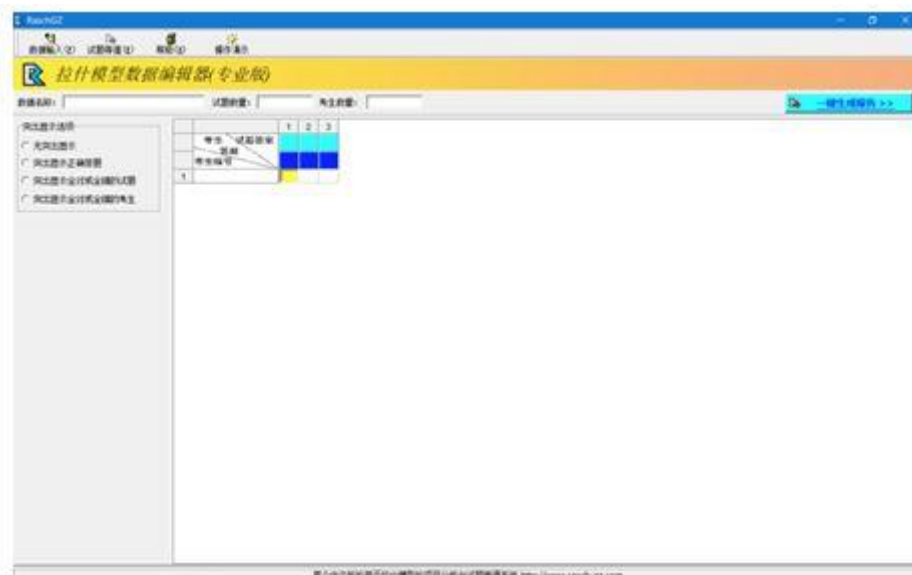

Figure4.2. *The data entry interface of Rasch-GZ*

4.2. Data input Method and Data File Storage

Like any other data processing system today, RASCH-GZ data entry is divided into manual entry and data file import. The data format accepts the text file format of GITEST and the data file format of EXCEL; the data type can be a char, such as: ABCDACDABACD, or an integer, such as: 101010101111100.

4.2.1. Manual Creation of Data Files

Manual creation of data files requires the following steps:

Step 1: Click "Data Input" in the upper left menu bar of Figure 4.2. The following interface will pop up, namely: the manual data input interface of the Rasch-GZ system as shown in Figure 4.3 below.

Figure4.3. *The manual data input interface of the Rasch-GZ system*

Step 2: Click the "Add New Test Items Section" button in Figure 4.3 to create the data file you want. At this time, we get the following interface, that is, the establishment of the data file format setting interface as shown in Figure 4.4 below.

Figure4.4. *The manual data file format setting interface*

Step 3: Please enter your own defined file name, number of test items, number of test takers and length of test takers' ID number according to the prompts in Figure 4.4 above. For example, in the first line, create your own first data file name in the space of the data name: GD08;

On the second line, enter 85 in the number of test items, indicating that we have 85 items; enter 100 in the number of test takers, indicating that we have 100 test takers; enter 9 in the box indicating the length of test takers' ID, indicating that the length of test takers' ID is 9 digits;

Starting from the third line, we entered each part of the test paper according to the prompts.

In the column of the serial number, we entered 1, 2, and 3 respectively, indicating that this test has three parts and the corresponding names of each part. They are LST (listening), GRM (grammar), and RDG (reading);

In the space of the number column, we entered the number of test items corresponding to the test, 20, 35, and 30 respectively, indicating that the listening part of this test has 20 items, the grammar part has 35 items, and 30 items in the reading section.

If the verification is correct, we will press the "OK" button to go to the next step.

Step 4: Click the "OK" button to create a data file according to the current data format, as shown in Figure 4.5 below:
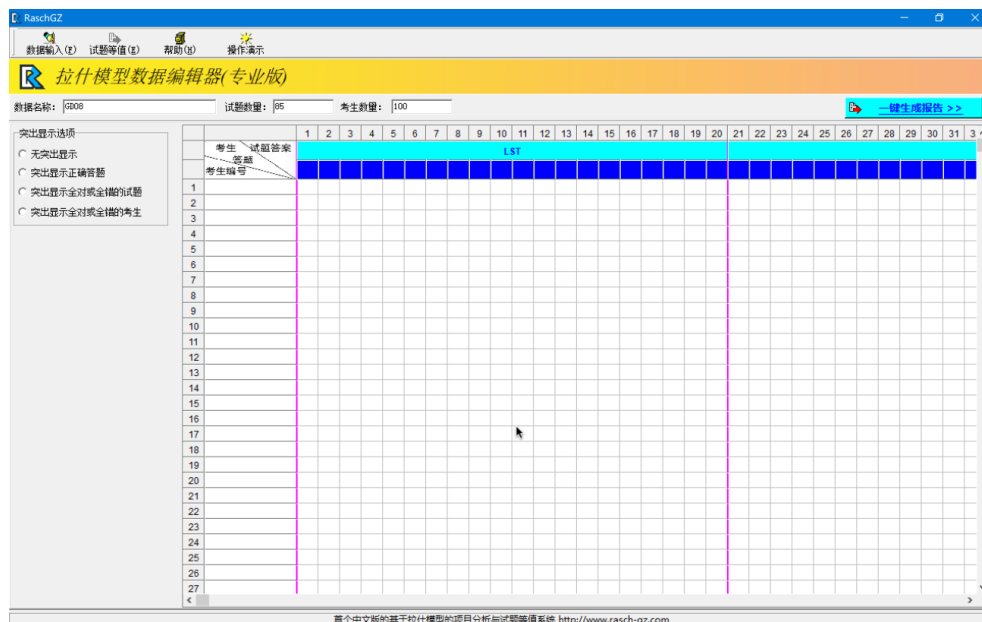

Figure4.5. *The data file format for manual inputting interface*

Step 5: now we start to manually input the data.

Enter the test takers' ID number in the form: Click on the first cell under "Student ID No." in the upper left corner of the form, a yellow input box will be displayed, and start to enter the test taker's ID number. The test takers' ID may be integers, or letters or combination of both. After the input is completed, press the Enter key to automatically enter the input box of the next test taker's ID until all test takers' IDs are input, as shown in Figure 4.6 below.
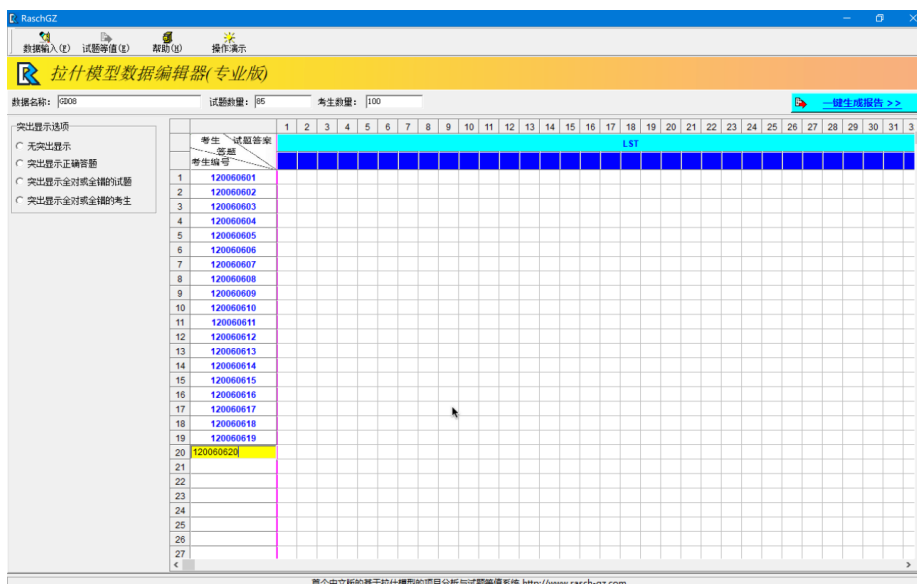

Figure4.6. *Rasch-GZ manual input test takers' ID data format interface*

Step 6: Enter the correct answers in the form:

Click on the first box with white background under "Examinees data" in the upper left corner of the form, a yellow input box will be displayed. Now, start to enter the correct answers of the test, i.e. keys, usually the characters A, B, C, and D. While entering the correct answers, enter one, press the Enter key once (yellow in the space behind), the system will automatically display next input box until all the answers have been entered.

In case the raw data are integers like 10101010001, it indicates that 1 means correct answer, and 0 means wrong answer. In such a case, no correct answers (keys) are provided, as shown in Figure 4.7 below
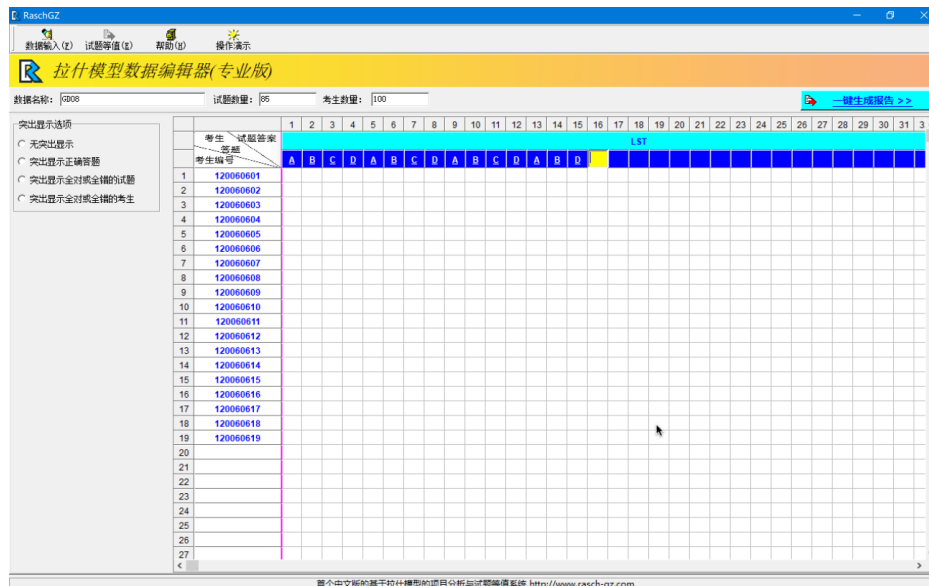

Figure4.7. *The interface for raw data of integers*

Step 7: Enter the raw data. Click the first cell with blue background on the right side of the "Raw Data" in the upper left corner of the table, a yellow input box will be displayed, and start to input the raw data. Usually, the original answers are Char such as A, B, C, or D, which are the options for multiple-choice question test type. When inputting these raw data, enter one char, press the Enter key once (the space behind it will appear yellow), the system will automatically display next box to input until all the raw data have been entered. Figure 4.8 below shows the basic data matrix format of the data file wherein the first column on the left is the test taker's ID number, the first row above is the correct answer. Staring from the second row, we have the test takers' raw data.
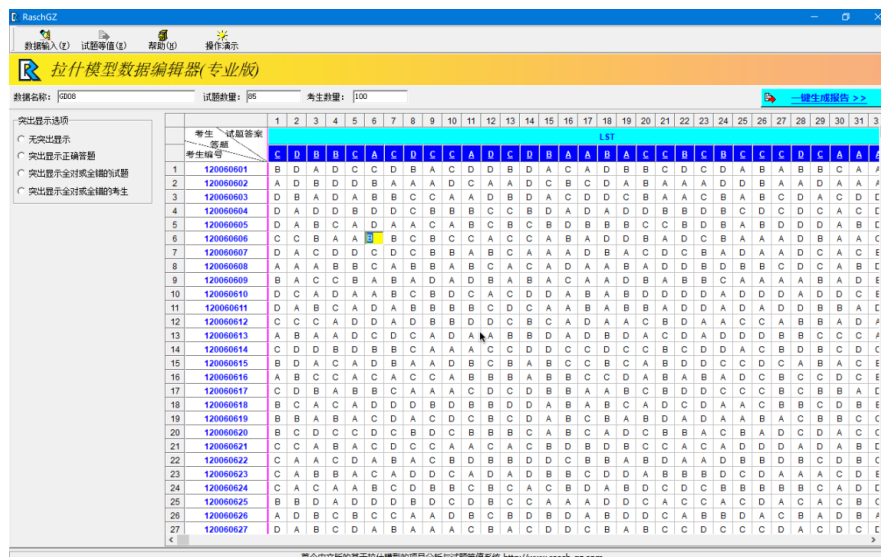

Figure4.8. *Basic data matrix format of RASCH-GZ data file*

Step 8: Save the current data file

Once the raw data input is done, check it! And make sure all are correct. From the "Data Input" menu in the upper left menu bar, click "Save" to save the currently input data. By this time, the system will pop up a window, indicating that you have successfully saved the data with the file name of "GD08" defined by yourself. At this time, the system automatically adds the suffix to "GD08.dat"

Step 9: One-click to quickly obtain the required analysis report file.

4.2.2. External Data File Import Method

If you already have a data file edited in Rasch-GZ format (see Figure 4.8 for details), you can directly import it into the Rasch-GZ system, and then with a click of mouse, you would quickly obtain an analysis report file. Currently Rasch-GZ accepts GITEST data text file format and EXCEL data file format.

(1) The way to import GITEST data edited in Rasch-GZ format goes as follows: Click "Import GITETEST Data" from the "Data Input" menu in the upper left corner of the menu bar, the system will pop up the following dialog box (see Figure 4.9), select the corresponding GETTEST format data file and open to the current data window to import data.
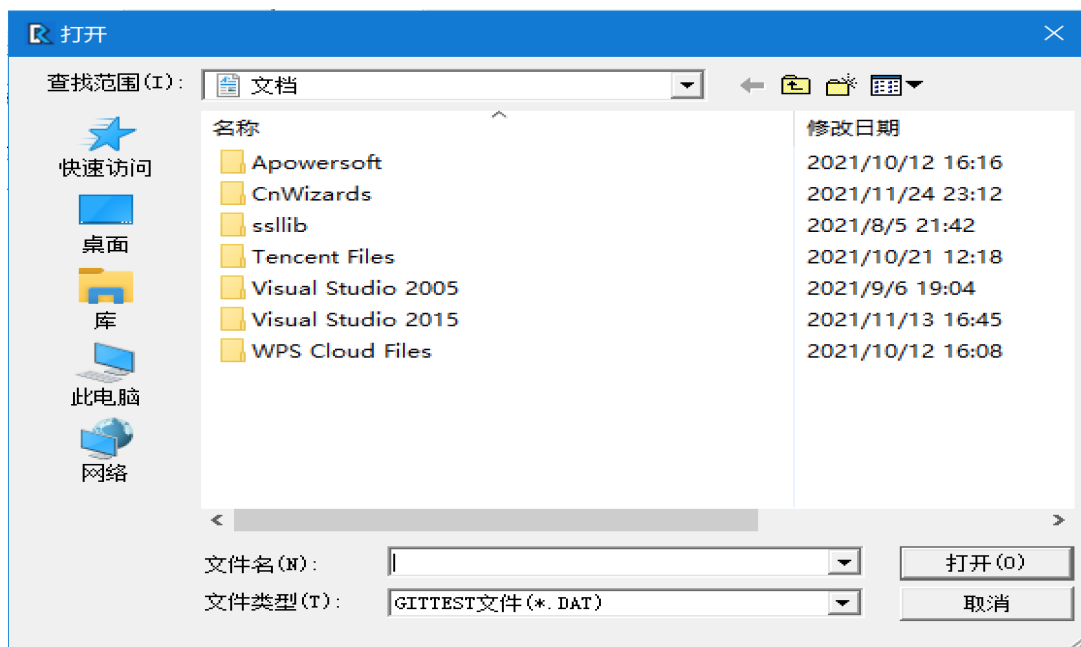
Figure4.9. *GITEST external data file import dialog*

(2) The way to import EXCEL data edited in Rasch-GZ format is as follows: Click "Import EXCEL Data" from the "Data Input" menu in the menu bar, the system will pop up the following dialog box (see Figure 4.10 below), select the corresponding EXCEL format data file, and open to the current data editing window to import data. Excel version supports older versions as well as versions after 2007. For details, see Figure 4.10 EXCEL External Data File Import Dialog Box.
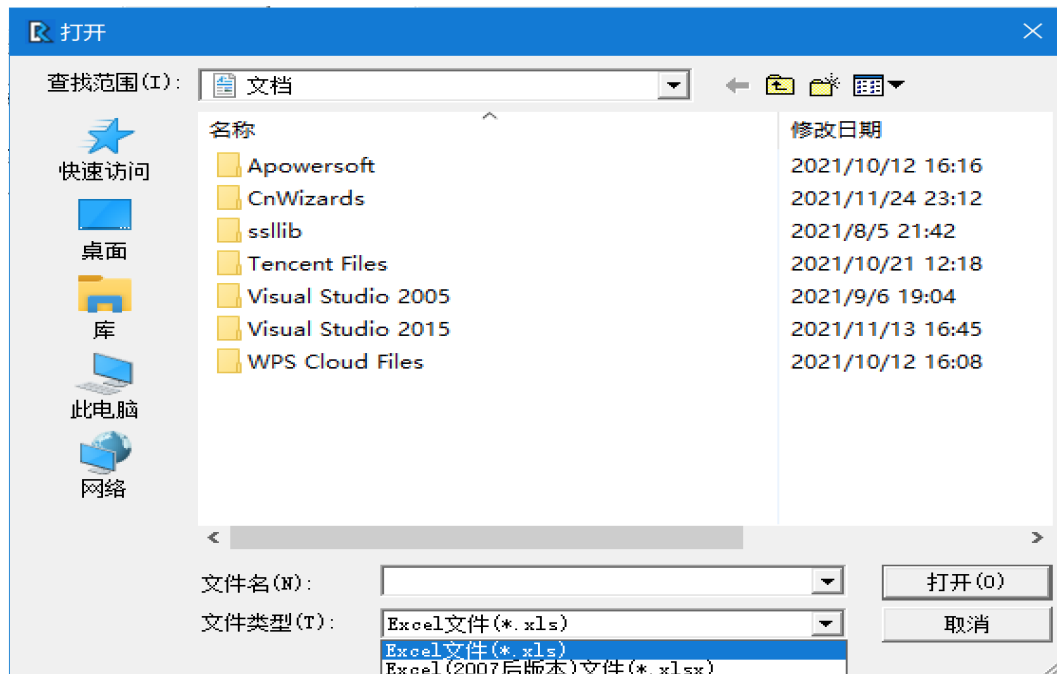
Figure4.10. *EXCEL external data file import dialog*

4.3. Obtain Data Analysis Reports

So long as the data file is imported successfully, or manually input is completed, and the user makes sure that all are correct, the required data analysis reports can be obtained. RASCH-GZ provides two ways to obtain data report files: the first one is to quickly generate all data analysis reports with one click; the second one is to click on the data analysis report specified by the user.

Click the "One-click Generate Analysis Report" button from the top of the table column. Rasch-GZ will automatically analyze the current data and generate relevant analysis reports within one or two seconds after the mouse click. If the data matrix is large, there will prompt a progressing bar during the data processing time. After the progress reaches 100%, we'll have the data analysis report viewing interface as shown in Figure 4.11.
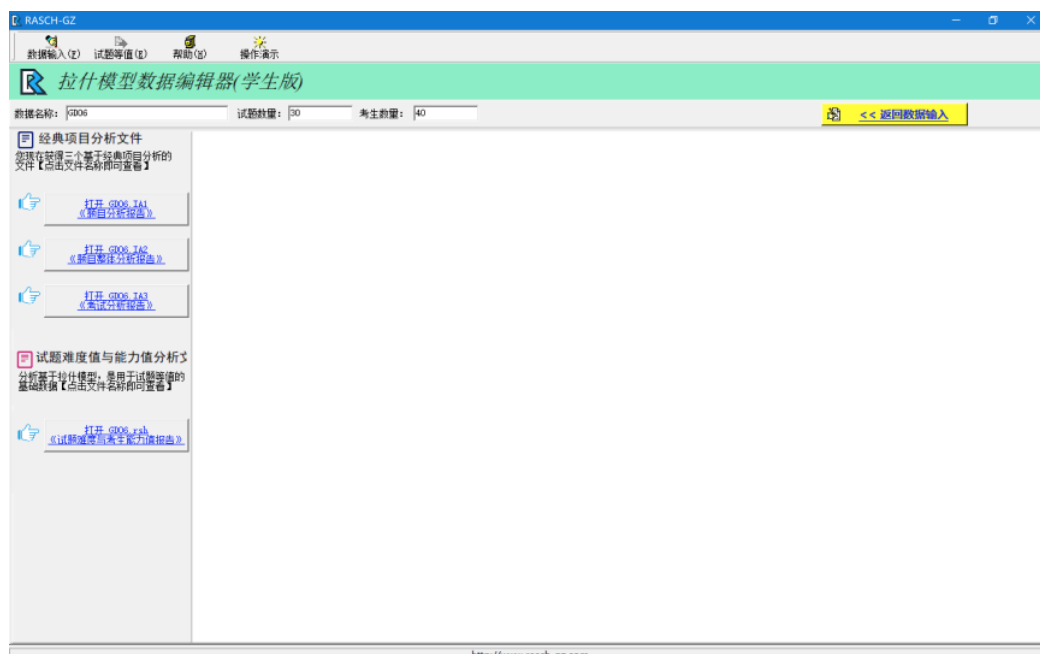

Figure4.11. *RASCH-GZ data analysis report viewing interface*

The interface description shown in Figure 4.11 is as follows:

There are four file names in the left column of Figure 4.11 above, with different suffixes. They are:

MFR Data 001.ia1 "Item Analysis Report for Each test item", (suffixed with ia1)

MFR Data 001.ia2 "Two-way report about difficulty-discrimination of all the test items in a whole test paper", (suffixed with ia2)

MFR Data 001.ia3 "An analysis report about a whole test paper ", (suffixed with ia3).

These three files, (as mentioned above), are based on the classic test theory, with the suffixes -.ia1-ia2 and –ia3 respectively.

Apart from this, there is another file with the suffix **–rsh,** i.e. MFR data 001.rsh.This file is the "test item difficulty/test taker ability report" based on Rasch model. **This data file with –rsh ending is an indispensable file for test equating.**

Sometimes, users only need to obtain a specific data file according to their own research purpose. In such a case, just click the required data analysis report. See Figure 4.12 below for details. Users need to get a specific data file interface.

Figure4.12. *Users' specific data file interface*

4.4. Other Data Related Operations

4.4.1. How to Open a Saved Data File

Click "Open" from the "Data Input" menu in the menu bar, and the "Open Data File" window will pop up. See Figure 4.13 below for details.

4.4.2. How to Open Recently Used Data Files

Click "Open Recently Used" from the "Data Input" menu in the menu bar, and the file names of the 5 recently used data files would be displayed in the lower menu. Click the selected file name to open the data and use it.

4.4.3. How to Moderate the Property Value of the Current Data

Click "Properties" from the "Data Input" menu in the menu bar to pop up the "Data Properties" window. Modifiable values include: data name, number of test items, number of test takers, length of test takers' ID, name and number of each section of the test paper.

Enter the new corresponding attribute value in the corresponding input box, and you can add or delete operations in the test section. Click the "OK" button to apply the modified properties, click the "Cancel" button to discard the modification.

Figure2.13. *Rasch-GZ "Open Data File" Interface*

4.4.4. Close the Current Data

Click "Close" from the "Data Input" menu in the menu bar to close the data currently being edited.

4.4.5. Save the Current Data as

Click "Save As" from the "Data Input" menu in the menu bar, and the "Data Properties" setting window will pop up to modify the new data name. Save the data currently being edited to a new data file.

5. SUMMARY

The Rasch model can provide a complete solution to almost every measurement problem encountered in the social sciences, and is especially suitable for researchers in professional fields such as language testing because the raw data of such disciplines are difficult to control and the concept is vague. The most updated Chinese version of RASCH-GZ has greatly promoted the use of Rasch model among Chinese speaking researchers. The author hereby reminds our readers that the easiest way to learn how to use Rasch model measurement is to download the student version of RASCH-GZ and user manual from the www.rasch-gz.com. The student version comes with a small data matrix (30 items x 40 candidates) and all result files at the click of a mouse. This offers good illustration regarding how helpful Rasch model is to the users' field of study or classroom teaching. If the result is satisfactory, but the amount of data to be analyzed is large, and test equating is needed, then the users could apply for the professional version of Rasch-GZ online. (To be continued)