MCMC Z-G IRT Model
Computer Program User's Guide
(Windows® Version 1.1)

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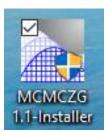
Robert Louden

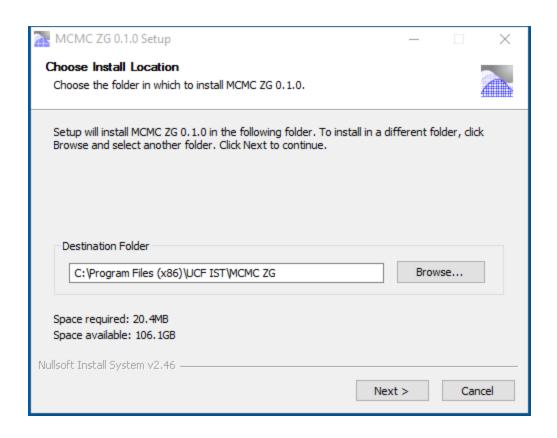University of Central Florida

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The MCMC Z-G computer program estimates the Zinnes–Griggs (Z-G) item response theory model (Z-G IRT; Zinnes & Griggs, 1974). Contrast to the GGUM2004 (Roberts, Fang, Cui, & Y. Wang, 2006) and the MCMC GGUM (W. Wang, de la Torre, & Drasgow, 2014) that calibrate the single-stimulus response data, the MCMC Z-G calibrate response data from the forced-choice measurement formats, which potentially address the response style and bias problem that are typically caused by the popular single-stimulus measurement formats. Similar to the MCMC GGUM (Wang, et al., 2014), the MCMC Z-G computer program also employs the Metropolis-within-Gibbs algorithm based Markov chain Monte Carlo method (Hastings, 1970; Metropolis, A. Rosenbluth, M. Rosenbluth, A. Teller, & E. Teller, 1953) and estimates both the item and person parameters, and it can handle missing values in the data. The MCMC Z-G program provides user friendly graphical interface; this User's Guide is written to provide some basic guidelines on using the program.
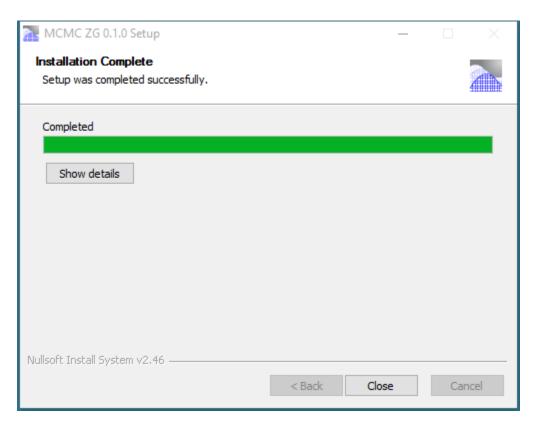
Download and Installation

The installer is available for free to download from the website at http://computationalpsychology.org/resources/. When it is properly downloaded, the installer file looks like the icon as follows on your desktop.

When double click the installer to install, it may require the administrator privilege to proceed. The installation starts with the following interface, where you may change and specify the destination folder for the installation. The default destination folder is shown in the following interface:

MCMC ZG 0.1.0 Setup — □ ✕

Choose Install Location

Choose the folder in which to install MCMC ZG 0.1.0.

Setup will install MCMC ZG 0.1.0 in the following folder. To install in a different folder, click Browse and select another folder. Click Next to continue.

Destination Folder

C:\Program Files (x86)\UCF IST\MCMC ZG   Browse...

Space required: 20.4MB
Space available: 106.1GB

Nullsoft Install System v2.46

Next >   Cancel

MCMC ZG 0.1.0 Setup — □ ✕

Installation Complete

Setup was completed successfully.

Completed

Show details

Nullsoft Install System v2.46
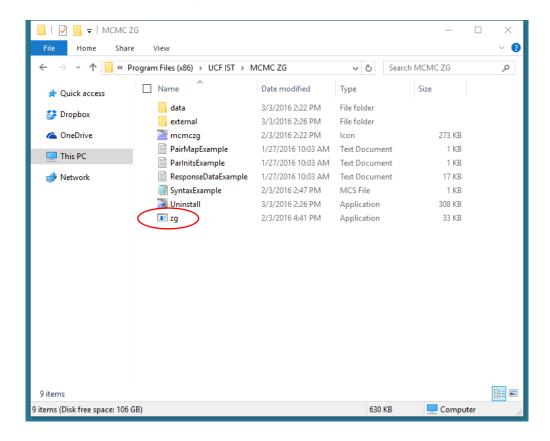
< Back   Close   Cancel

Then follow the instruction, and click "Next" to complete the installation. When the installation is completed, close the interface window. A shortcut of the application will be created on the desktop. Click the shortcut to open/execute the program.

Another way (also recommended) to open/execute the program is to find the executable file located in the installation folder, as circled in the screenshot below.
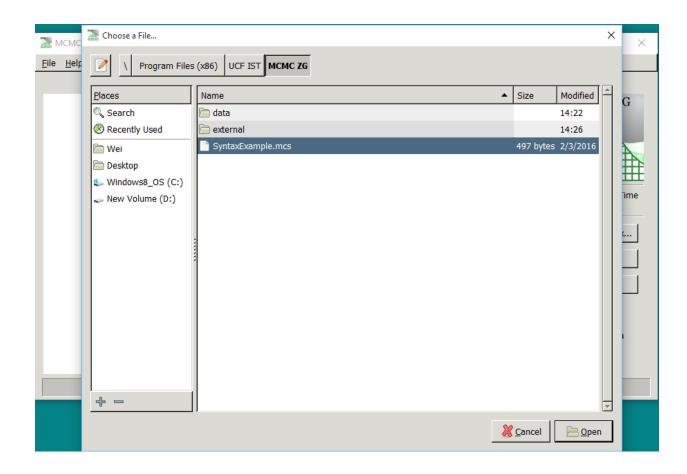

Running the Program

To run the program properly, first, <u>make sure that both the syntax file and the data file are located in the main folder of the installation folder</u>. The details of a syntax file will be elaborated in the following section.
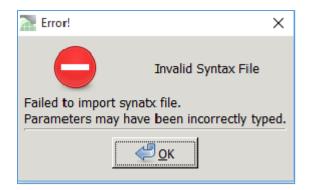
The following two screenshots show the Window interfaces of the MCMC Z-G Program. Click "Import Syntax" button on the right side to locate and import a syntax file. If a syntax file is properly written, no error message would appear, and you may click "Run" button to run the program.
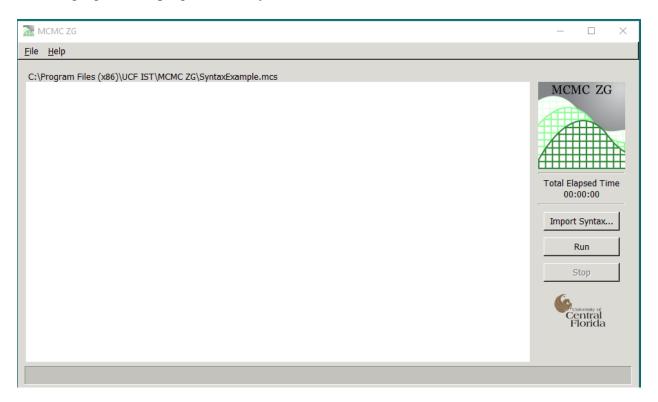

Clicking the Import Syntax button will open a new window shown below, which allows for a syntax file to be appropriately located. Once the designated syntax file is found and highlighted, click "Open" to close the new window and get the program ready to run.

When a syntax file contains an error, an error message as below may appear. Common errors include a misspecification of data location or data information (e.g., numbers of rows and columns). Other common errors may be mismatched vectors for the parameters.

If a syntax file contains no errors and is imported properly, the window interface displays the correct directory of the syntax file at the upper left corner of the window, as shown in the following figure. The program is ready to run.
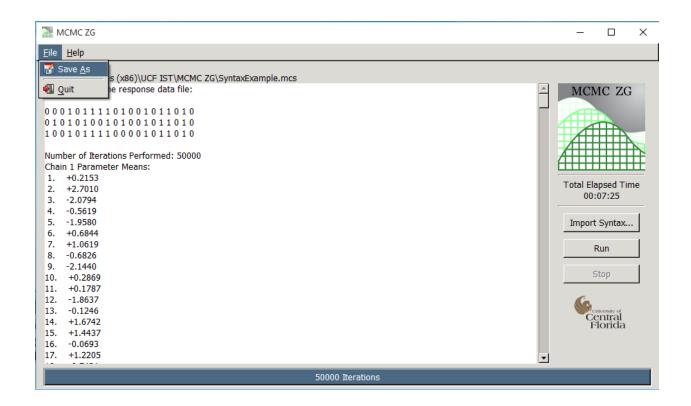

When the program is running, the time elapsed will be displayed on the right side above the "Import Syntax" button, and a blue bar at the bottom of the interface will present the progress of the completed iterations, as shown in the following screenshot.

When the program finishes the prescribed length of iterations, the parameter estimates and relevant output information are displayed in the main window of the program as shown below. The output information will be further discussed in a separate section later on.

There are two buttons in the menus at the upper-left corner of the window interface: **File** and **Help**. The drop-down list of File menu includes Save As and Quit. The Save As option is used to save the output file. The Help menu provide brief "About" information regarding this computer program. Note it took about 7 minutes to finish three chains of 50,000 iterations, which is considered fast for MCMC estimation.

Syntax and Data Files

A sample syntax file named SyntaxExample is provided with the installation of the program. Users only need to slightly modify the syntax entries in order to run the program. The sample syntax and its explanation are presented as follows.

The first three entries of the syntax file specify the name and location for the files of data, pair mapping specification, initial values. If these files are located in the installation folder, there is no need to further specify the file directory.

The 4 to 7 entries specify the numbers of respondents, items, statements, and chains, respectively, the 8 and 9 entries determine the length of the chains (typically 50,000 iterations) and burn-ins. Lastly, the standard deviation of sampling theta candidate and mu candidates can

be specified. These values affect acceptance rates. The smaller the standard deviation is, the

higher the acceptance rate will become.

Response data can be stored in a text file, with columns are separated by a space or tab. An example of the data file format is provided below.

```
ResponseDataExample - Notepad                    —    □    ✕

File  Edit  Format  View  Help

0 0 0 1 0 1 1 1 1 0 1 0 0 1 0 1 1 0 1 0
0 1 0 1 0 1 0 0 1 0 1 0 0 1 0 1 1 0 1 0
1 0 0 1 0 1 1 1 1 0 0 0 0 1 0 1 1 0 1 0
1 1 0 0 1 0 0 0 1 1 1 1 0 1 1 0 0 0 0
1 0 0 0 0 1 1 0 0 0 1 0 1 1 1 0 0 0 1 1
1 1 1 0 0 1 1 0 0 0 1 1 1 1 1 0 0 0 1
1 0 0 1 0 0 1 1 1 0 1 0 1 1 0 1 0 0 1 1
1 0 1 0 0 0 1 0 0 1 1 1 1 0 0 0 0 1 0 1
1 0 0 0 0 1 1 1 0 1 1 1 0 1 0 1 0 0 1 0
1 0 0 0 1 0 1 0 0 1 1 0 0 1 1 0 0 0 0 1
1 1 1 0 1 0 1 0 0 1 1 1 1 0 1 0 0 1 0 1
1 0 0 1 0 1 0 1 1 0 1 0 0 1 0 1 1 0 1 0
1 0 1 0 1 0 1 1 0 1 1 1 0 0 1 1 0 0 0 1
1 1 1 0 1 0 1 1 0 1 1 0 1 0 1 0 0 1 0 1
0 0 0 1 0 1 0 1 1 0 0 0 0 0 0 1 1 0 1 0
1 0 0 1 0 1 0 0 0 0 1 0 0 1 0 1 1 0 1 0
1 0 0 0 0 1 1 0 1 1 0 0 0 1 1 1 1 0 1 1
1 0 0 1 0 1 1 1 0 0 1 0 0 1 1 1 1 0 1 0
1 1 1 0 1 0 1 0 0 1 1 0 1 0 1 0 0 1 1 1
1 0 0 0 0 0 1 1 1 1 0 0 0 0 1 0 0 1 1
1 0 0 1 0 1 1 1 0 1 1 0 0 0 0 1 1 0 0 1
1 1 1 1 1 0 1 0 1 1 1 1 0 0 0 0 1 0 1
1 0 0 1 0 1 0 1 1 1 1 0 0 1 0 1 0 0 0 0
1 0 1 1 1 0 1 0 0 1 1 0 0 0 1 0 0 1 1 1
1 0 0 1 0 1 0 1 1 0 1 0 1 1 1 1 0 0 0 0
0 0 0 0 0 1 1 0 1 0 1 0 0 1 1 1 1 0 0 0
```

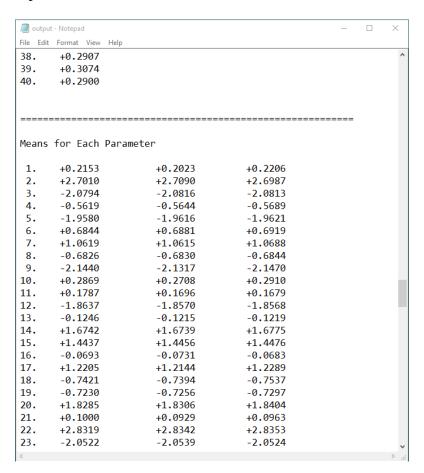**Output Files**

The output of the program is displayed in the main window and can also be saved in a text file by clicking the **Save As** option from the File drop-down menu. The output file presents information in the following order:

(1) First 3 files of the response data file;

(2) Number of iterations;

(3) Matrix of the means of item parameter (number of item parameters × number of chains);

(4) Matrix of the standard error of item parameter (number of item parameters × number of chains);

(5) Vector of the averaged means of item parameters cross chains;

(6) Vector of the averaged standard deviation of item parameters cross chains;

(7) Matrix of the means of person parameter (number of person parameters × number of chains);

(8) Matrix of the standard error of person parameter (number of person parameters × number of chains);

(9) Vector of the averaged means of person parameters cross chains;

(10)   Vector of the averaged standard deviation of person parameters cross chains;

(11)   Acceptance rates.

```
output - Notepad                                          —    □    ×
File  Edit  Format  View  Help
38.      +0.2907
39.      +0.3074
40.      +0.2900


===========================================================

Means for Each Parameter

 1.      +0.2153          +0.2023          +0.2206
 2.      +2.7010          +2.7090          +2.6987
 3.      -2.0794          -2.0816          -2.0813
 4.      -0.5619          -0.5644          -0.5689
 5.      -1.9580          -1.9616          -1.9621
 6.      +0.6844          +0.6881          +0.6919
 7.      +1.0619          +1.0615          +1.0688
 8.      -0.6826          -0.6830          -0.6844
 9.      -2.1440          -2.1317          -2.1470
10.      +0.2869          +0.2708          +0.2910
11.      +0.1787          +0.1696          +0.1679
12.      -1.8637          -1.8570          -1.8568
13.      -0.1246          -0.1215          -0.1219
14.      +1.6742          +1.6739          +1.6775
15.      +1.4437          +1.4456          +1.4476
16.      -0.0693          -0.0731          -0.0683
17.      +1.2205          +1.2144          +1.2289
18.      -0.7421          -0.7394          -0.7537
19.      -0.7230          -0.7256          -0.7297
20.      +1.8285          +1.8306          +1.8404
21.      +0.1000          +0.0929          +0.0963
22.      +2.8319          +2.8342          +2.8353
23.      -2.0522          -2.0539          -2.0524
```

References

Hastings, W. K. (1970). Monte Carlo sampling methods using Markov Chains and their applications. *Biometrika, 57,* 97–109.

Metropolis, N., Rosenbluth, A. W., Rosenbluth, M. N., Teller, A. H., & Teller, E. (1953). Equations of state calculations by fast computing machines. *Journal of Chemical Physics, 21,* 1087–1092.

Roberts, J. S., Fang, H., Cui, W., & Wang, Y. (2006). GGUM2004: A Windows-based program to estimate parameters in the generalized graded unfolding model. *Applied Psychological Measurement, 30,* 64-65.

Wang, W., de la Torre, J., & Drasgow, F. (2014). MCMC GGUM: A New Computer Program for Estimating Unfolding IRT Models. Applied Psychological Measurement. doi: 10.1177/0146621614540514

Zinnes, J. L., & Griggs, R. A. (1974). Probabilistic, multidimensional unfolding analysis. Psychometrika, 39, 327–350.