

IRT in BILOG-MG3

# What is BILOG-MG3?

- Analysis of **binary items** (multiple choice or short-answer items scored right, wrong, omitted, or not presented).
- Perform **item analysis and scoring** of any number of subtests or subscales in a single program run.

# Phase of Analysis

## Phase 1: INPUT

Reads formatted data records. For omits and attempts, they may be scored “wrong,” partially correct, or omitted from calculation.

Classical item statistics are accumulated:

1. Item facilities (% correct)
2. Item-subscore correlations
3. # respondents attempting each item.

## Phase 2: INPUT

Fits the logistic item-response function (1PL, 2PL, or 3PL) to each item of each subscale and estimates parameters.

1. Marginal MLE of item parameters: respondents are randomly drawn from a distribution.
2. Maximum marginal a posteriori estimation of item parameters: specify priors.
3. Fit statistics

## Phase 3: SCORE

Uses the master response file from Phase 1 and the item parameter estimates from Phase 2 to compute rescaled scores for respondents.

Methods for scale score calculation:

1. Maximum Likelihood
2. Bayes or Expected a posteriori
3. Bayes or maximum a posteriori

# Output Files

- **Phase 1 (\*.ph1):** includes test and item identification and classical item statistics
- **Phase 2 (\*.ph2):** includes assumed prior distributions, estimated item parameters, standard errors, and goodness of fit, etc.
- **Phase 3 (\*.ph3):** includes assumed prior distributions of the scale scores for MAP and EAP estimation, scale score of subjects, etc.

# Installing a Trial Version of BILOG

The screenshot shows a web browser window with the address bar displaying <http://www.ssicentral.com/irt/downloads.html>. The website is for SSI Scientific Software International. A sidebar on the left contains a menu with the following items: About, LISREL, HLM, IRT, SuperMix, Ordering, Workshops, Other Products, FAQs, and Contact Information. The main content area lists trial versions of several software products. The first section, titled "Installation instructions for internet installation applications", includes a bullet point: "Please use the special installation instructions to install the trial editions of the IRT software products." Below this, the "Free 15-day trial edition of BILOG-MG 3 for Windows" is highlighted with a red circle. It includes a bullet point: "Please note that the only limitation of the 15-day trial edition of BILOG-MG for Windows is that it expires 15 days after installation." and a sub-heading: "Free 15-day trial edition of BILOG-MG for Windows (August 2008)". Other trial versions listed are MULTILOG 7, PARSCALE 4, and TESTFACT 4, each with similar notes and sub-headings for August 2008.

**SSI SCIENTIFIC SOFTWARE INTERNATIONAL**

Free Hotmail | Suggested Sites | Web Site Gallery | **SSI** | Other bookmarks

[http://www.ssicentral.com/irt/downloads.html](#)

**Installation instructions for internet installation applications**

- Please use the special installation instructions to install the trial editions of the IRT software products.

**Free 15-day trial edition of BILOG-MG 3 for Windows**

- Please note that the only limitation of the 15-day trial edition of BILOG-MG for Windows is that it expires 15 days after installation.

**Free 15-day trial edition of BILOG-MG for Windows (August 2008)**

**Free 15-day trial edition of MULTILOG 7 for Windows**

- Please note that the only limitation of the 15-day trial edition of MULTILOG for Windows is that it expires 15 days after installation.

**Free 15-day trial edition of MULTILOG for Windows (August 2008)**

**Free 15-day trial edition of PARSCALE 4 for Windows**

- Please note that the only limitation of the 15-day trial edition of PARSCALE for Windows is that it expires 15 days after installation.

**Free 15-day trial edition of PARSCALE for Windows (August 2008)**

**Free 15-day trial edition of TESTFACT 4 for Windows**

- Please note that the only limitation of the 15-day trial edition of TESTFACT for Windows is that it expires 15 days after installation.

**Menu:**

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# Example 1: Fitting a 3PL Model

- Taken from [Example 1 of BILOG](#)
- 15 item test
- 1000 test takers
- Need to score data or enter raw data to be scored using key file
- [Fit the 3PL IRT Model](#)

# Data file

Examinee ID

(4 characters, including space)

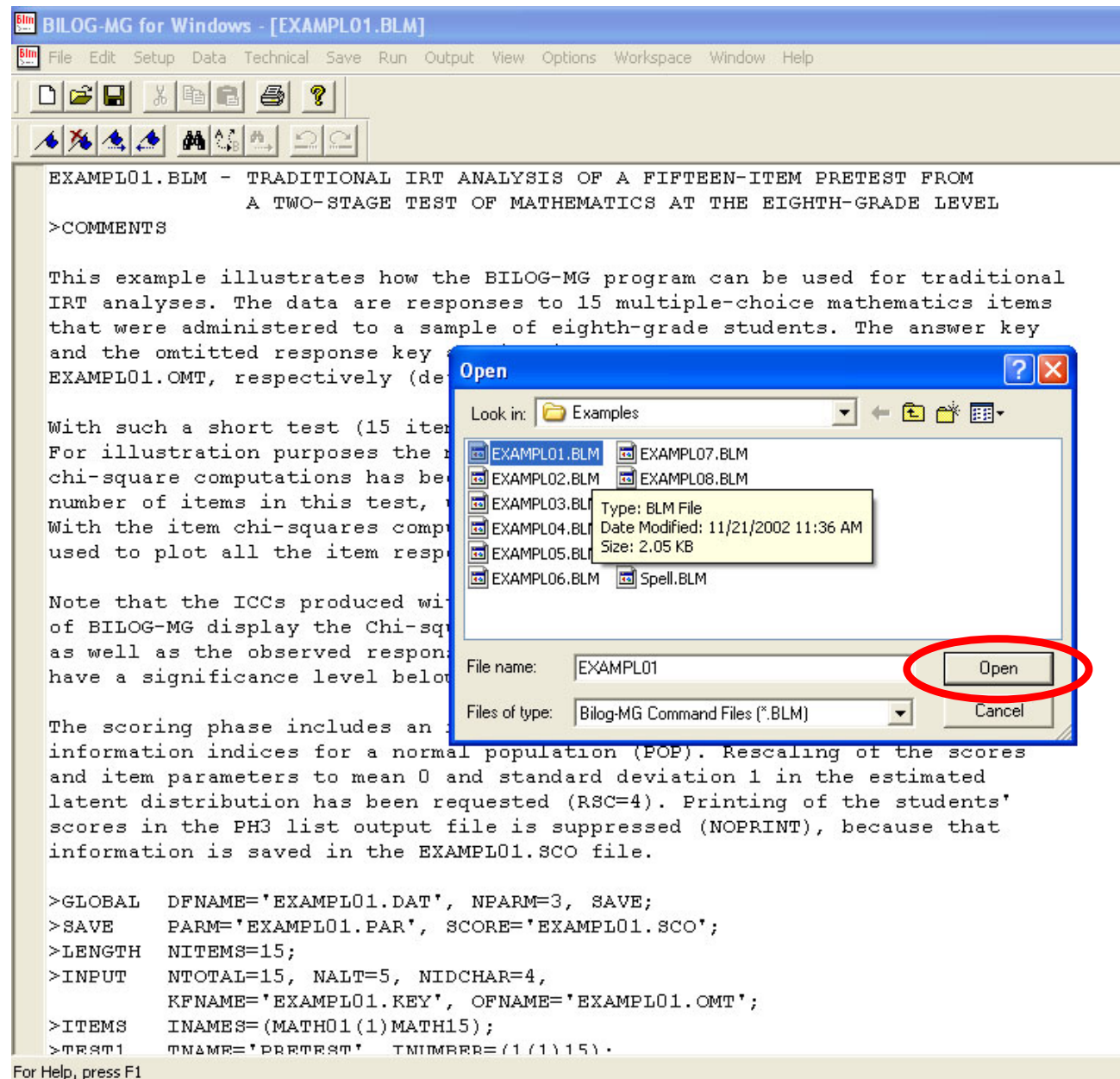
Space between examinee ID and  
the response

Dichotomous response pattern

(4A1,1X,15A1)

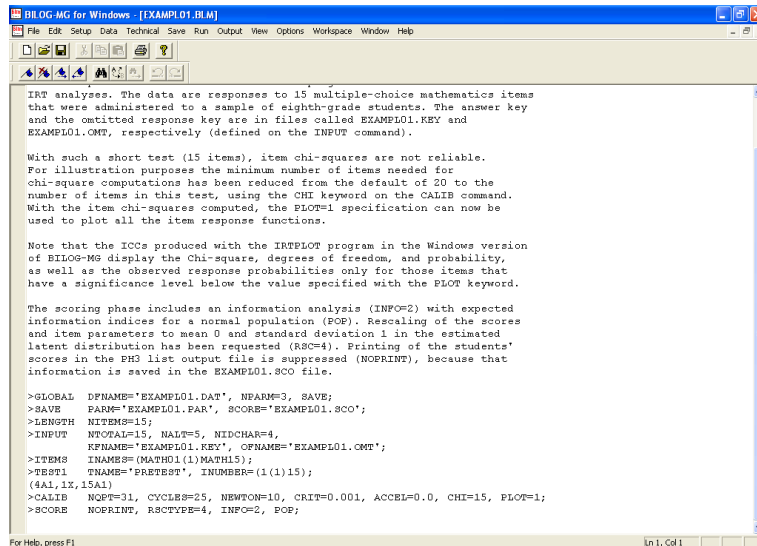
	Examinee ID	Space	Dichotomous response pattern
1	2423		11431435242
2	2433		23413213131
3	1422		12441212312
4	3412		11323253521
5	3433		21411213113
6	3412		32413211114
7	3424		12411212121
8	2413		12321444231
9	3414		22323411211
10	4141		3451242323
11	4424		24411414111
12	3424		12112413141
13	3413		22223443321
14	3431		115214313354
15	2413		21123413349
16	3413		14413413113
17	3414		21121411412
18	3413		14441213121
19	3423		12411213223
20	3413		24451213221
21	3423		13223213111
22	3413		13221212112
23	4424		11131224113
24	3433		13121211321
25	3423		23421213131
26	3433		11491213242
27	3214		21323242242
28	3414		22323342241
29	4414		21413213341
30	4423		12441313211

# Loading a BILOG-MG Example





# Problems with Building Syntax



```
BILOG-MG for Windows - [EXAMPLE1.BLM]
File Edit Setup Data Technical Save Run Output View Options Workspace Window Help

IKT analyses. The data are responses to 15 multiple-choice mathematics items
that were administered to a sample of eighth-grade students. The answer key
and the omitted response key are in files called EXAMPLE1.KEY and
EXAMPLE1.OMT, respectively (defined on the INPUT command).

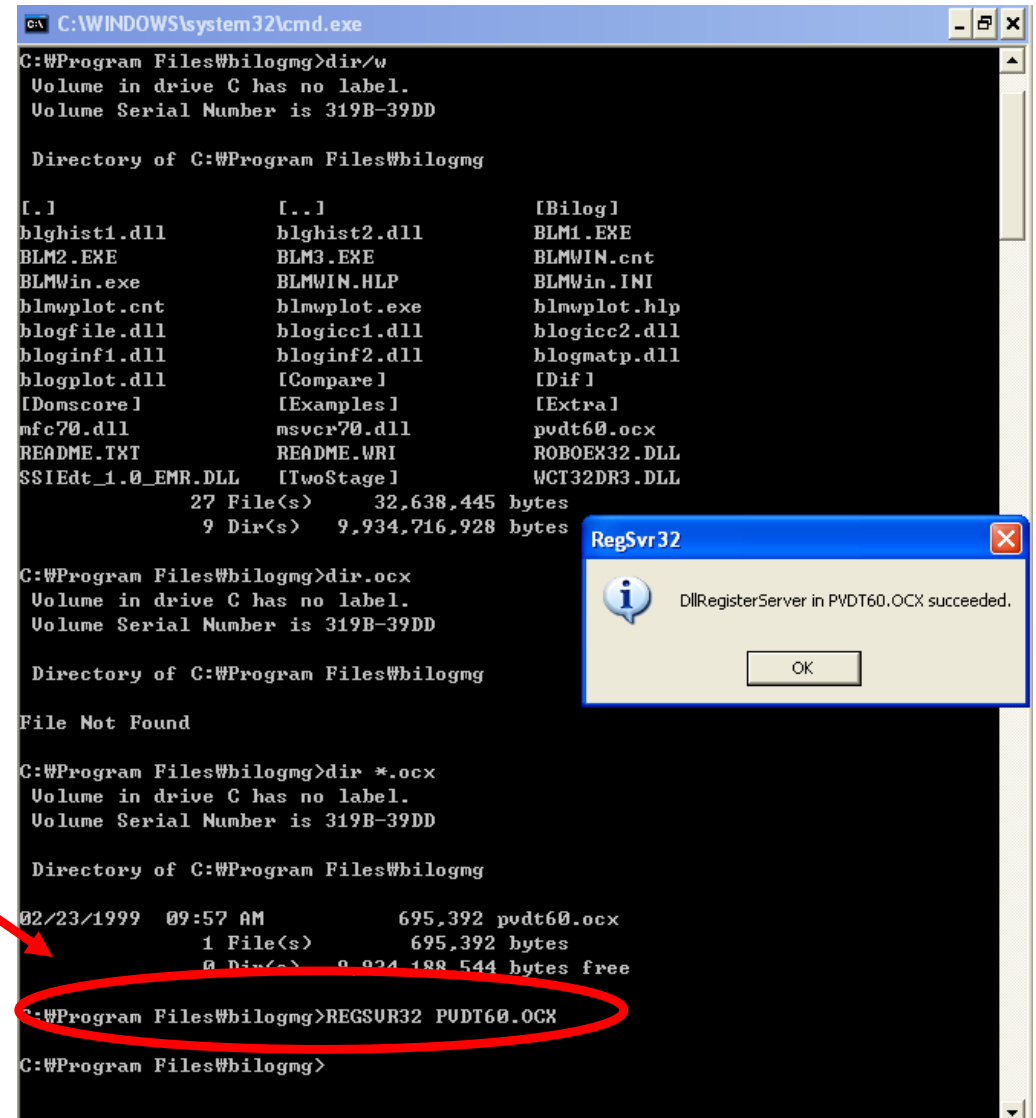
With such a short test (15 items), item chi-squares are not reliable.
For illustration purposes the minimum number of items needed for
chi-square computations has been reduced from the default of 20 to the
number of items in this test, using the CHI keyword on the CALIB command.
With the item chi-squares computed, the PLOT=1 specification can now be
used to plot all the item response functions.

Note that the ICCs produced with the IRTEPLOT program in the Windows version
of BILOG-MG display the Chi-square, degrees of freedom, and probability,
as well as the observed response probabilities only for those items that
have a significance level below the value specified with the PLOT keyword.

The scoring phase includes an information analysis (INFO=2) with expected
information indices for a normal population (POP). Rescaling of the scores
and item parameters to mean 0 and standard deviation 1 in the estimated
latent distribution has been requested (RSC=4). Printing of the students'
scores in the PM3 list output file is suppressed (NOPRINT), because that
information is saved in the EXAMPLE1.SCO file.

>GLOBAL  DNAME='EXAMPLE1.DAT', NPAR=3, SAVE;
>SAVE    PAR='EXAMPLE1.PAR', SCORE='EXAMPLE1.SCO';
>LENGTH NITEMS=15;
>INPUT   NTOTAL=15, NALT=5, NIDCHAR=4,
          RNAME='EXAMPLE1.REX', OFNAME='EXAMPLE1.OMT';
>ITEMS   INAMES=(MATH1(1)MATH15);
>TEST1   TNAME='PRETEST', INUMBER=(1(1)15);
          (4A1,1X,15A1)
>CALIB   NQF=31, CYCLES=25, NEWTON=10, CRIT=0.001, ACCEL=0.0, CHI=15, PLOT=1;
>SCORE   NOPRINT, RSCTYPE=4, INFO=2, POP;
```

If you experience problems building syntax, you may need to reactivate the PVDT60.OCX file in the directory where BILOG is installed.



```
C:\WINDOWS\system32\cmd.exe

C:\Program Files\biologmg>dir/w
Volume in drive C has no label.
Volume Serial Number is 319B-39DD

Directory of C:\Program Files\biologmg

[.]                [..]                [Bilog]
blghist1.dll        blghist2.dll        BLM1.EXE
BLM2.EXE            BLM3.EXE            BLMWIN.cnt
BLMWin.exe          BLMWIN.HLP          BLMWin.INI
blmwplot.cnt        blmwplot.exe        blmwplot.hlp
blogfile.dll        blogicc1.dll         blogicc2.dll
bloginf1.dll        bloginf2.dll        blogmatp.dll
blogplot.dll        [Compare]           [Dif]
[Domscore]          [Examples]           [Extra]
mfc70.dll           msver70.dll         pvdt60.ocx
README.TXT          README.WRI           ROBOEX32.DLL
SSIEdt_1.0_EM.RDLL [TwoStage]          WCT32DR3.DLL
                    27 File(s)          32,638,445 bytes
                    9 Dir(s)          9,934,716,928 bytes

C:\Program Files\biologmg>dir.ocx
Volume in drive C has no label.
Volume Serial Number is 319B-39DD

Directory of C:\Program Files\biologmg

File Not Found

C:\Program Files\biologmg>dir *.ocx
Volume in drive C has no label.
Volume Serial Number is 319B-39DD

Directory of C:\Program Files\biologmg

02/23/1999  09:57 AM                695,392 pvdt60.ocx
1 File(s)                695,392 bytes
0 Dir(s)              9,934,716,928 bytes free

C:\Program Files\biologmg>REGSUR32 PVDT60.OCX

C:\Program Files\biologmg>
```

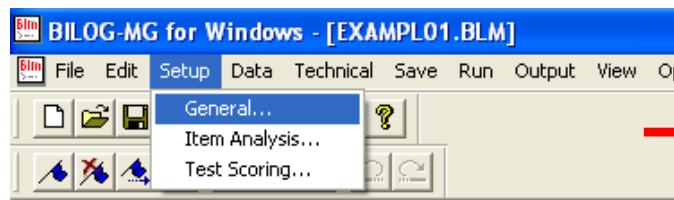
RegSvr32

DllRegisterServer in PVDT60.OCX succeeded.

OK

# Building Syntax (1)

STEP 1



General

Job Description | Model | Response | Labels

Title (2 lines of 78 columns max):  
EXAMPL01.BLM - TRADITIONAL IRT ANALYSIS OF A FIFTEEN-ITEM  
A TWO-STAGE TEST OF MATHEMATICS AT THE EIG

Line: Col

Comment (78 columns per line max):  
This example illustrates how the BILOG-MG program can be used for IRT analyses. The data are responses to 15 multiple-choice items that were administered to a sample of eighth-grade students and the omitted response key are in files called EXAMP.

Total Number of Items: 15

Number of Subtests: 1 Number of Test Forms: 1

Number of Examinee Groups: 1 Reference Group: 1

OK Cancel Help

General

Job Description | Model | Response | Labels

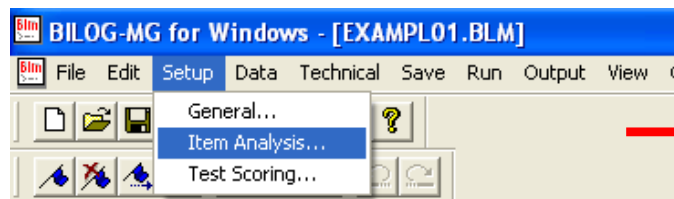
Response Model:  
☐ 1-Parameter Logistic (1PL)  
☐ 2-Parameter Logistic (2PL)  
☒ 3-Parameter Logistic (3PL)

Response Function Metric:  
☒ Normal  
☐ Logistic

Special Models:  
☒ Standard  
☐ Differential Item Functioning (DIF)  
☐ Item Parameter Drift (DRIFT)  
☐ Variant Item Analysis (VARIANT)

OK Cancel Help

STEP 2



Item Analysis

Subtests | Subtest Items | Advanced

Subtest Label	Subtest Length	Number of Variant Items	Analyze this row
PRETEST	15	0	Y

OK Cancel Help

Item Analysis

Subtests | Subtest Items | Advanced

Convergence Criterion: 0.001 Maximum Number of EM Cycles: 25  
Maximum Number of Newton Cycles: 10

Chi-square Item Fit Statistics:  
Minimum Number of Items Required for Chi-square: 15  
Number of Ability Intervals for Computing Chi-square: 9

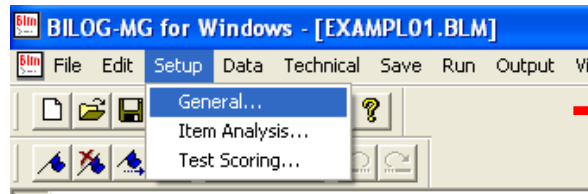
Number of Quadrature Points: 15

Prior Item Constraints:  
☐ Prior on Threshold  
☒ Prior on Slope  
☐ Prior on Guessing

☐ Empirical Latent Distribution  
☐ Estimate Parameters Constraint Means

OK Cancel Help

# Building Syntax (2)



STEP 3

Examinee Data

General Data File Enter Data

Number of Case ID Characters: 4

Case Samples

- ☒ Use All Data
- ☐ Number of Cases Sampled for Item Analysis (All cases will be scored) SAMPLE = 1000
- ☐ Number of Initial Cases to Take for Testing Job Setup TAKE = ALL

☐ Case Weights

☐ Group Specific Subtests

☐ External Ability Criterion and Standard Error

OK Cancel Help

Examinee Data

General Data File Enter Data

Data File Name: EXAMPL01.DAT Browse... Show Data

Read as Free-Column, Space Delimited Records.

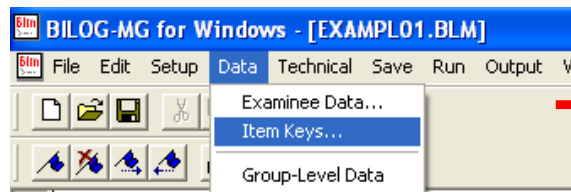
☒ Read as Fixed-Column Records: Number of Data Record Per Case: 1

Data Field (Left-Right order)	Column First	Column Last	Data Field (Left-Right order)	Column First	Column Last	Precision Decimal
Case ID	1	4	Case Weight	0	0	2
Form Number	0	0	External Ability	0	0	0
Group Number	0	0	Ability S.E.	0	0	0
	0	0	Response String	6	20	0

Format String: (4A1,1X,15A1)

Set Fields Set Format

OK Cancel Help



STEP 4

EXAMPL01 - WordPad

File Edit View Insert Format Help

KEY 341421323441413

Item Keys

Answer Key Not Presented Key Omit Key

Possible Key Codes: 01234

Item Key File Name: EXAMPL01.KEY

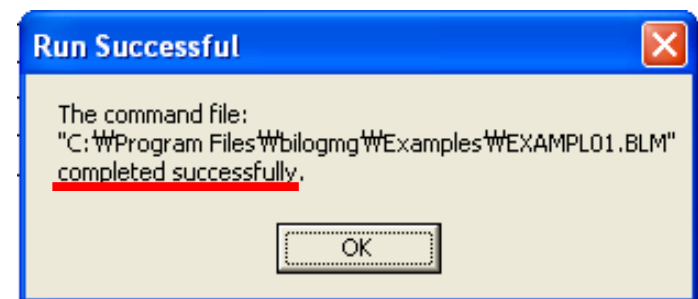
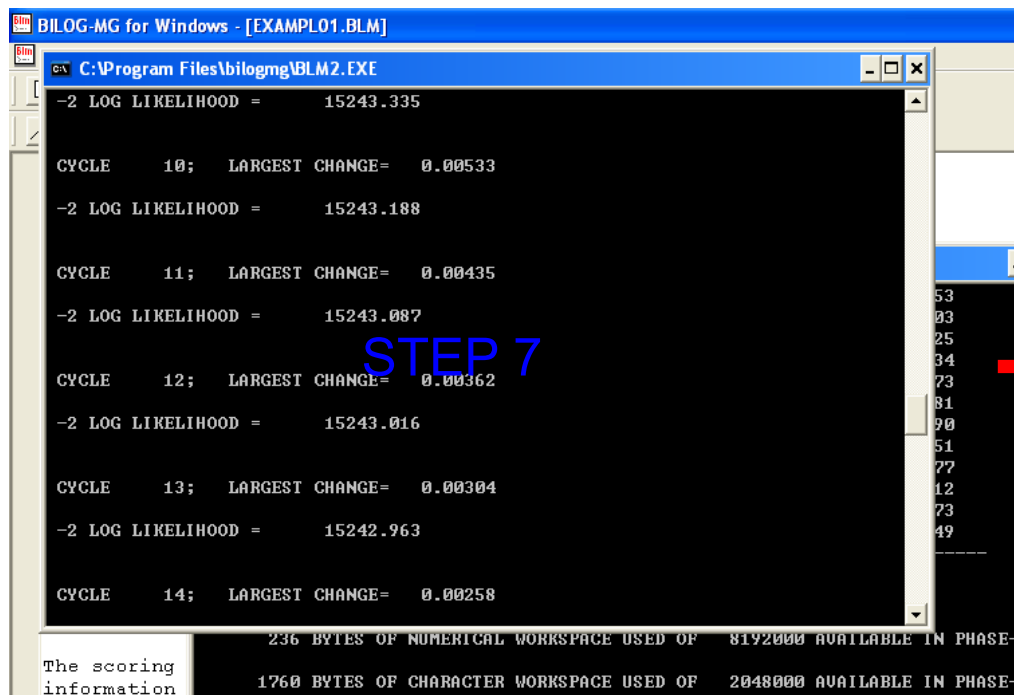
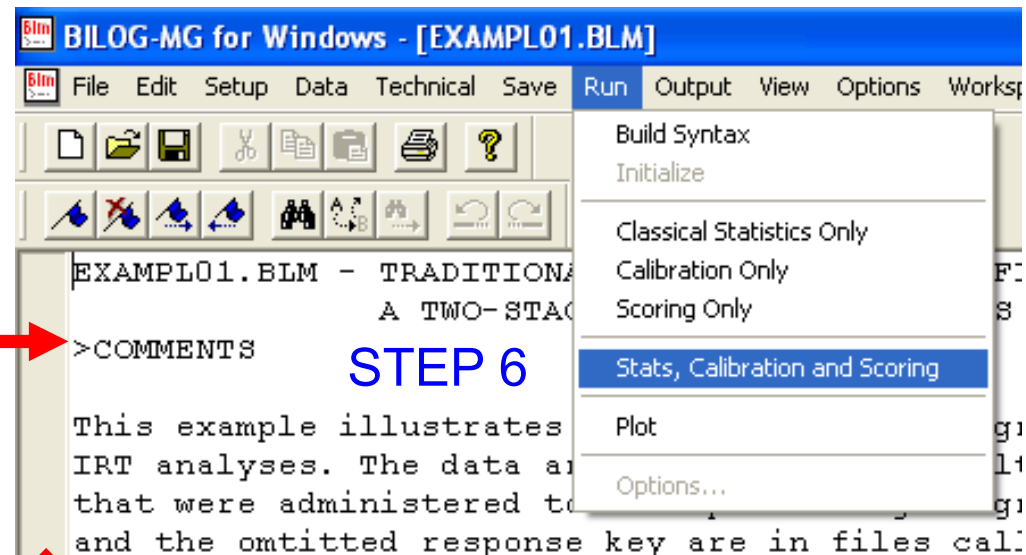
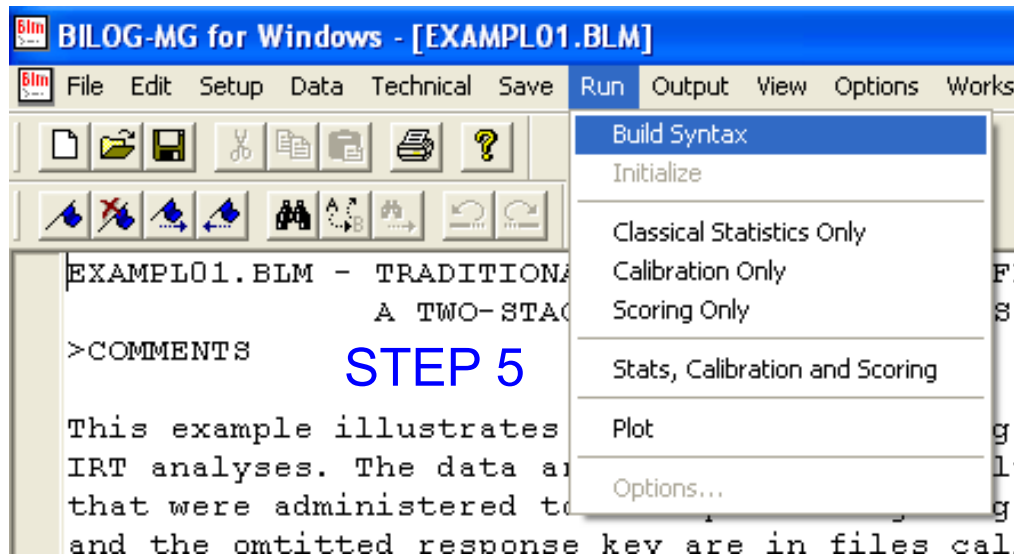
Number of Data Record Per Case: 1

Form	Answer Key
1	341421323441413

Length Col

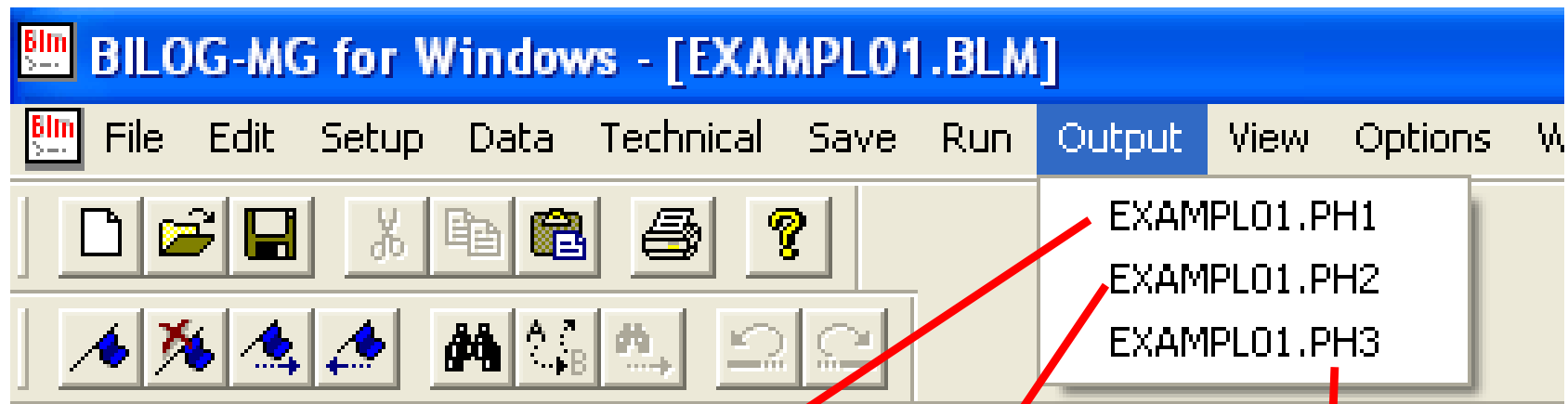
OK Cancel Help

# Building Syntax (3)



**STEP 8: FINISHED  
RUNNING!**

# BILOG OUTPUT (1)



## PHASE 1 OUTPUT:

BASIC INFORMATION  
AND CLASSICAL ITEM  
ANALYSIS STATISTICS

## PHASE 2 OUTPUT:

ITEM PARAMETERS, ITEM  
FIT STATISTICS, ICC

## PHASE 3 OUTPUT:

ABILITY ESTIMATES AND  
FIT STATISTICS

# BILOG OUTPUT (2): PHASE 1

BILOG-MG for Windows - [EXAMPL01]

File Edit View Options Window Help

1000 OBSERVATIONS WRITTEN TO FILE: MF.DAT

ITEM STATISTICS FOR SUBTEST PRETEST

CLASSICAL ITEM STATISTICS

ITEM	NAME	#TRIED	#RIGHT	PCT	LOGIT/1.7	ITEM*TEST CORRELATION	
						PEARSON	BISERIAL
1	MATH01	1000.0	844.0	84.4	-0.99	0.274	0.415
2	MATH02	1000.0	972.0	97.2	-2.09	0.112	0.285
3	MATH03	1000.0	696.0	69.6	-0.49	0.356	0.468
4	MATH04	1000.0	503.0	50.3	-0.01	0.442	0.553
5	MATH05	1000.0	594.0	59.4	-0.22	0.477	0.603
6	MATH06	1000.0	539.0	53.9	-0.09	0.498	0.625
7	MATH07	1000.0	499.0	49.9	0.00	0.586	0.734
8	MATH08	1000.0	570.0	57.0	-0.17	0.375	0.473
9	MATH09	1000.0	624.0	62.4	-0.30	0.534	0.681
10	MATH10	1000.0	398.0	39.8	0.24	0.465	0.590
11	MATH11	1000.0	459.0	45.9	0.10	0.598	0.751
12	MATH12	1000.0	390.0	39.0	0.26	0.454	0.577
13	MATH13	1000.0	182.0	18.2	0.88	0.419	0.612
14	MATH14	1000.0	227.0	22.7	0.72	0.196	0.273
15	MATH15	1000.0	155.0	15.5	1.00	0.098	0.149

# BILOG OUTPUT (3): PHASE 2

BILOG-MG for Windows - [EXAMPL01.PH2]

File Edit View Options Window Help

CYCLE 29; LARGEST CHANGE= 0.00109

-2 LOG LIKELIHOOD: 15242.2685

CYCLE 30; LARGEST CHANGE= 0.00095

INTERVAL COUNTS FOR COMPUTATION OF ITEM CHI-SQUARES

43.	92.	124.	134.	139.	138.	141.	87.	102.
-----	-----	------	------	------	------	------	-----	------

INTERVAL AVERAGE THETAS

-1.882	-1.345	-0.971	-0.547	-0.112	0.285	0.702	1.141	1.730
--------	--------	--------	--------	--------	-------	-------	-------	-------

1

SUBTEST PRETEST ; ITEM PARAMETERS AFTER CYCLE 30

ITEM	INTERCEPT S.E.	SLOPE S.E.	THRESHOLD S.E.	LOADING S.E.	ASYMPTOTE S.E.	CHISQ (PROB)	DF
MATH01	1.041 0.107*	0.651 0.082*	-1.599 0.242*	0.545 0.069*	0.186 0.084*	29.0 (0.0007)	9.0
MATH02	2.230 0.165*	0.600 0.114*	-3.717 0.610*	0.514 0.098*	0.199 0.089*	9.5 (0.0920)	5.0
MATH03	0.428 0.106*	0.693 0.084*	-0.618 0.190*	0.569 0.069*	0.159 0.071*	63.2 (0.0000)	7.0

DEVIANCE:  
USED FOR  
LIKELIHOOD  
RATIO TESTS

ITEM FIT  
STATISTIC

# BILOG OUTPUT (4): PHASE 3

BILOG-MG for Windows - [EXAMPL01.PH3]

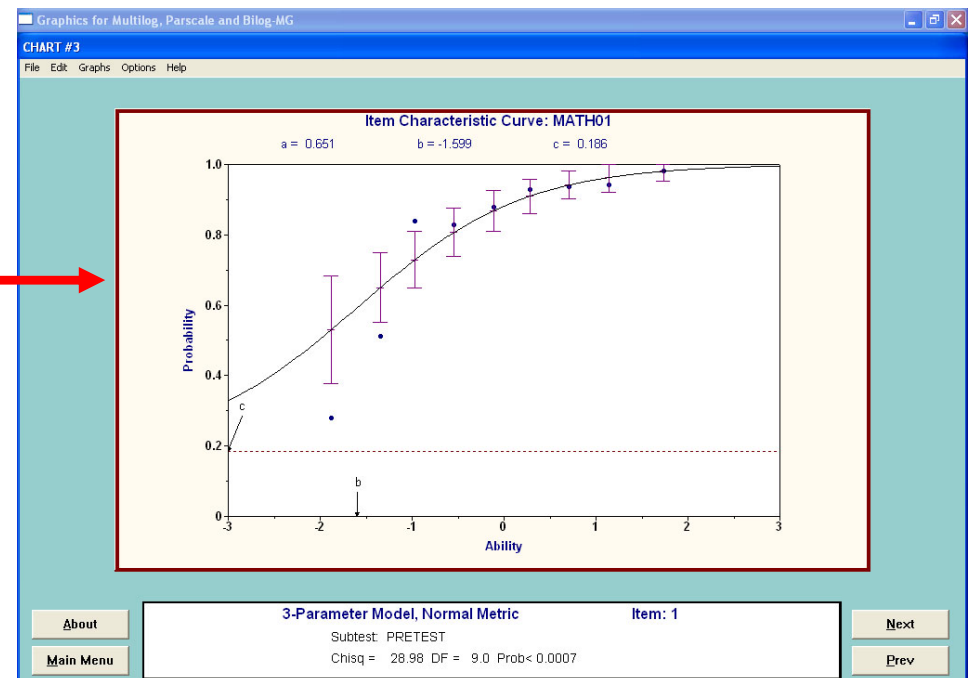
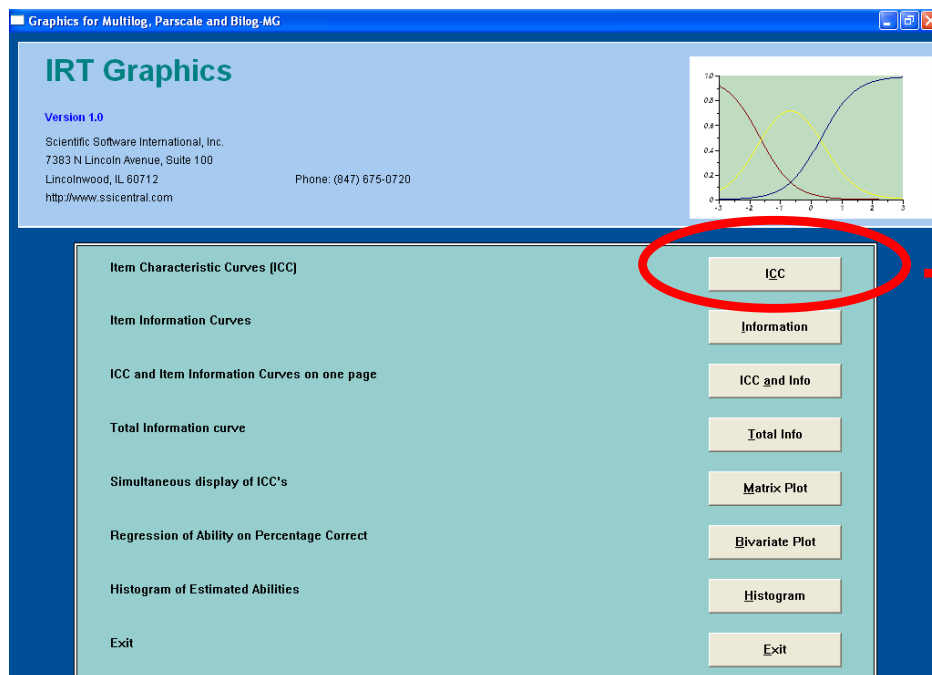
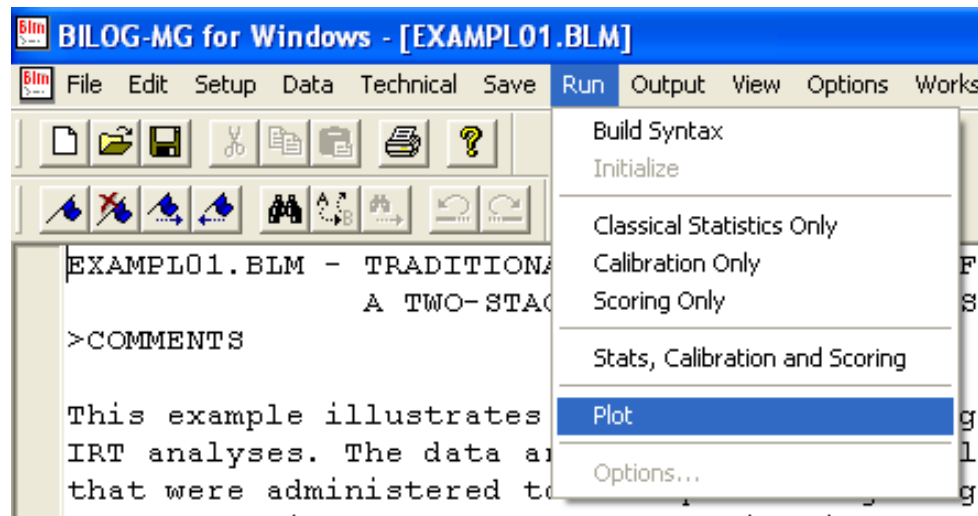
File Edit View Options Window Help

TEST TAKER ID TEST TAKERS' ABILITY ESTIMATES

GROUP WEIGHT	SUBJECT IDENTIFICATION	TRIED	RIGHT	PERCENT	ABILITY	S.E.	MARGINAL PROB
	TEST						
1	1						
1.00	PRETEST	15	3	20.00	-1.3136	0.6720	0.000220
1	2						
1.00	PRETEST	15	3	20.00	-0.9683	0.6135	0.000592
1	3						
1.00	PRETEST	15	2	13.33	-1.5954	0.6057	0.001068
1	4						
1.00	PRETEST	15	7	46.67	-0.0055	0.4823	0.000619
1	5						
1.00	PRETEST	15	6	40.00	-0.7824	0.5159	0.000042
1	6						
1.00	PRETEST	15	6	40.00	-0.6073	0.4269	0.000194
1	7						
1.00	PRETEST	15	3	20.00	-1.2304	0.5886	0.003407
1	8						
1.00	PRETEST	15	6	40.00	-0.2175	0.4952	0.000014
1	9						
1.00	PRETEST	15	11	73.33	0.5189	0.2845	0.000177
1	10						



# BILOG Graphics Interface



# Example 2: DIF

**General**

Job Description | Model | Response | Labels

Title (2 lines of 78 columns max):  
EXAMPLO2.BLM - MALE VS FEMALE DIFFERENTIAL ITEM FUNCTIONING  
SPELLING, GIRDER ITEM 4, OTHER 3 ITEMS 1-3

Line: Col:

Comment (78 columns per line max):  
This problem is based on an example in Thissen, Steinberg. The data are drawn from a 100 word spelling test administered to psychology students at a large university. The words were randomly selected from a popular word book for secretaries.

Total Number of Items: 4

Number of Subtests: 1

Number of Examinee Groups: 2

Number of Test Forms: 1

Reference Group: 1

OK Cancel Help

**General**

Job Description | Model | Response | Labels

Response Model

☒ 1-Parameter Logistic (1PL)  
☐ 2-Parameter Logistic (2PL)  
☐ 3-Parameter Logistic (3PL)

Response Function Metric

☐ Normal  
☒ Logistic

Special Models

☐ Standard  
☒ Differential Item Functioning (DIF)  
☐ Item Parameter Drift (DRIFT)  
☐ Variant Item Analysis (VARIANT)

OK Cancel Help

Differences in specification of syntax

# BILOG Sample Output

BILOG-MG for Windows - [EXAMPL02 \*]

File Edit View Options Window Help

SUBTEST 1 SPELL

GROUP 1 MALES 16 OBSERVATIONS

GROUP 2 FEMALES 15 OBSERVATIONS

SUBTEST 1 SPELL

ITEM STATISTICS FOR GROUP: 1 MALES

ITEM	NAME	#TRIED	#RIGHT	PCT	LOGIT	ITEM*TEST CORRELATION	
						PEARSON	BISERIAL
1	SP1	285.0	215.0	0.754	-1.12	0.243	0.332
2	SP2	285.0	181.0	0.635	-0.55	0.351	0.450
3	SP3	285.0	91.0	0.319	0.76	0.364	0.474
4	SP4	285.0	179.0	0.628	-0.52	0.360	0.461

ITEM STATISTICS FOR GROUP: 2 FEMALES

ITEM	NAME	#TRIED	#RIGHT	PCT	LOGIT	ITEM*TEST CORRELATION	
						PEARSON	BISERIAL
1	SP1	374.0	305.0	0.816	-1.49	0.254	0.370
2	SP2	374.0	230.0	0.615	-0.47	0.295	0.376
3	SP3	374.0	109.0	0.291	0.89	0.231	0.307
4	SP4	374.0	171.0	0.457	0.17	0.306	0.385

PHASE 1

BILOG-MG for Windows - [EXAMPL02.PH2 \*]

File Edit View Options Window Help

MODEL FOR GROUP DIFFERENTIAL ITEM FUNCTIONING:  
ADJUSTED THRESHOLD VALUES

ITEM	GROUP	
	1	2
SP1	-1.159	-1.615
	0.130*	0.131*
SP2	-0.583	-0.627
	0.119*	0.106*
SP3	0.785	0.720
	0.085*	0.112*
SP4	-0.552	0.012
	0.117*	0.104*

\*STANDARD ERROR

MODEL FOR GROUP DIFFERENTIAL ITEM FUNCTIONING:  
GROUP THRESHOLD DIFFERENCES

ITEM	GROUP 2 - 1
SP1	-0.456
	0.185*
SP2	-0.043
	0.159*
SP3	-0.064
	0.141*
SP4	0.564
	0.156*

\*STANDARD ERROR

PHASE 2