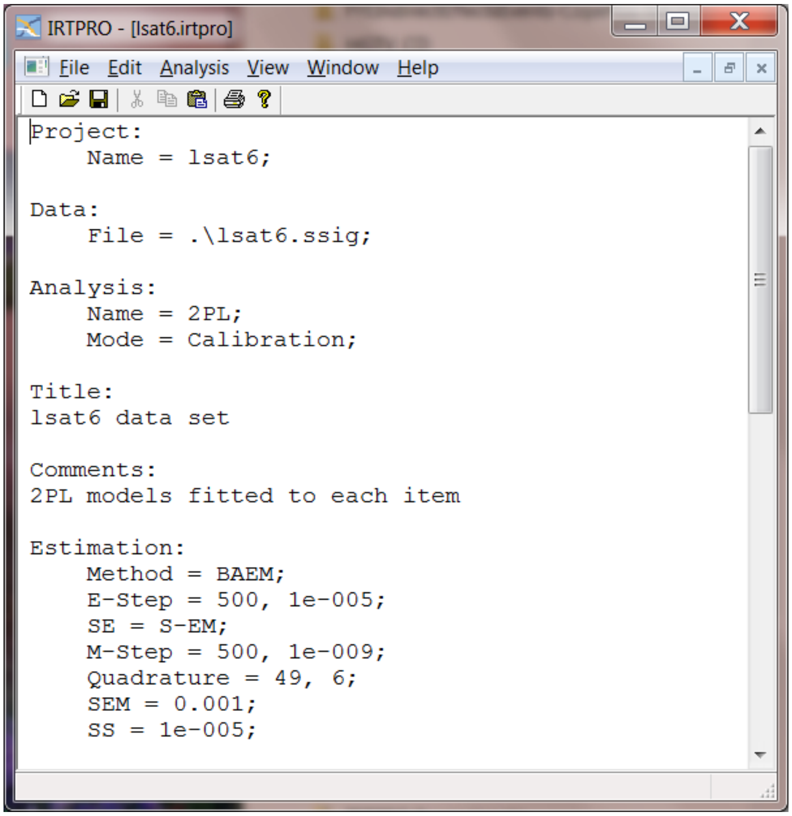
IRTPRO™

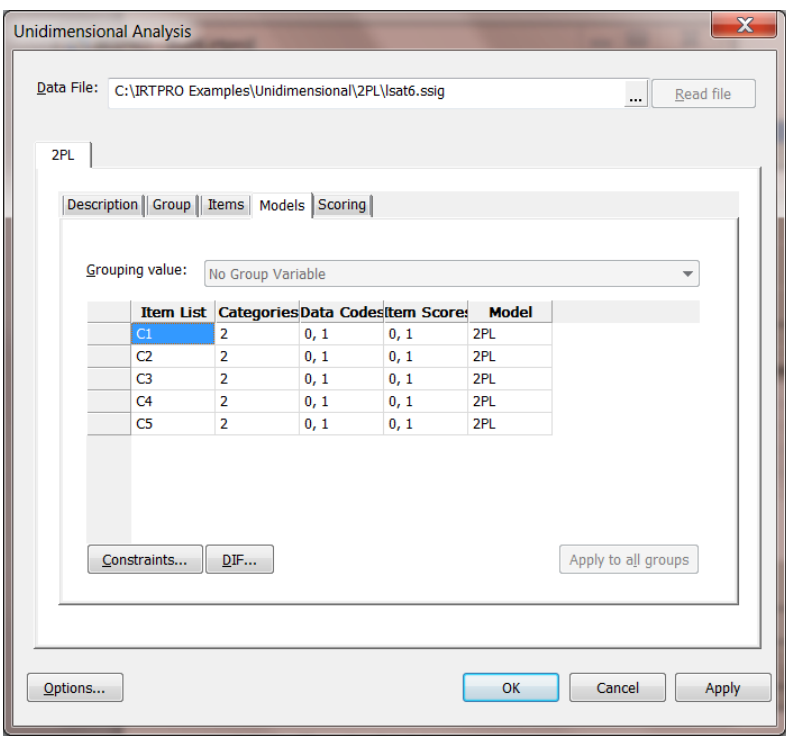
Contents

1. Estimation methods and settings

A brief discussion of the IRTPRO's estimation methods and their control parameters is provided in this chapter. To see the dialog boxes that permit access to the control parameters, open the syntax file **lsat6.irtpro** from the **IRTPRO Examples\Unidimensional\2PL** folder, a portion of which is displayed below.

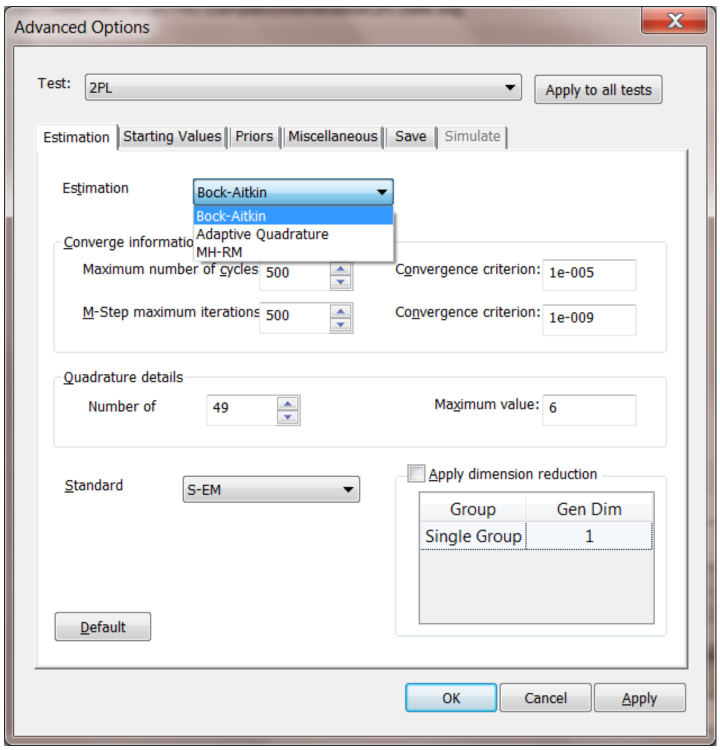


Next, select the **Analysis, Unidimensional** option from the main menu bar and click the **Options** button shown at the bottom of the **Unidimensional Analysis** window on the left.

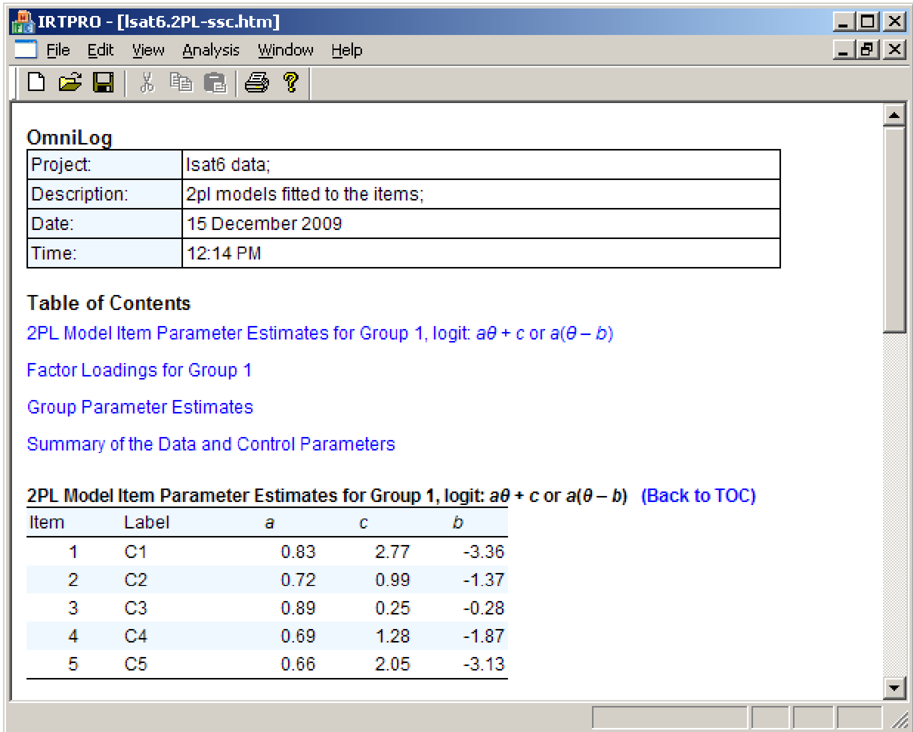


1.1 Bock-Aitkin EM

The default estimation method for a unidimensional analysis is the Bock-Aitkin method and the **Advanced Options** window shown below shows the default estimation settings. A researcher has the option to change these settings, for example, the number of quadrature points, the range over which these points are spread, the maximum number of cycles (E-step) and the maximum number of iterations (M-step).

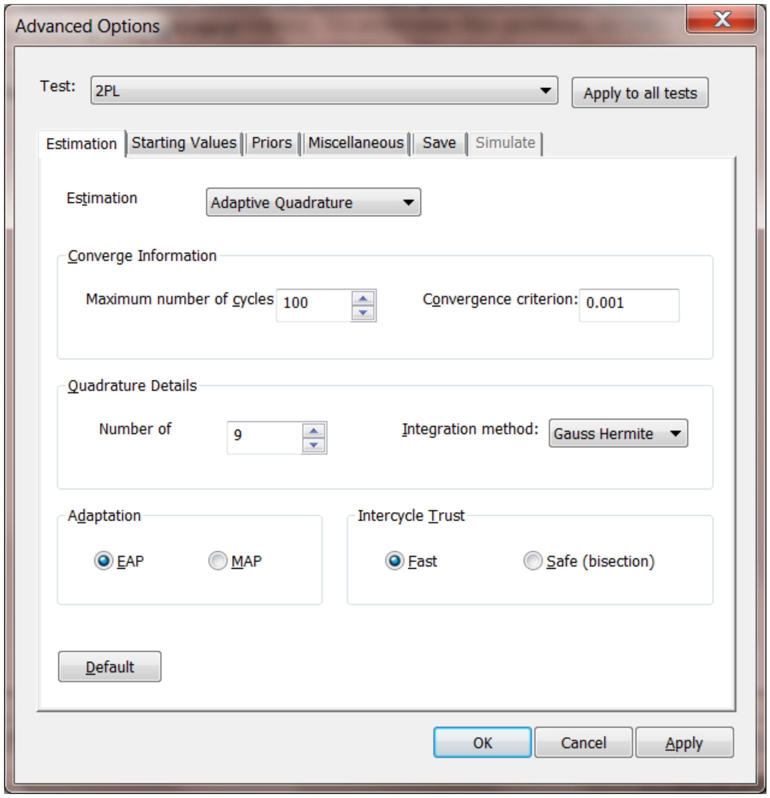


A portion of the output, listing the parameter estimates for the Bock-Aitkin estimation method, is shown below.

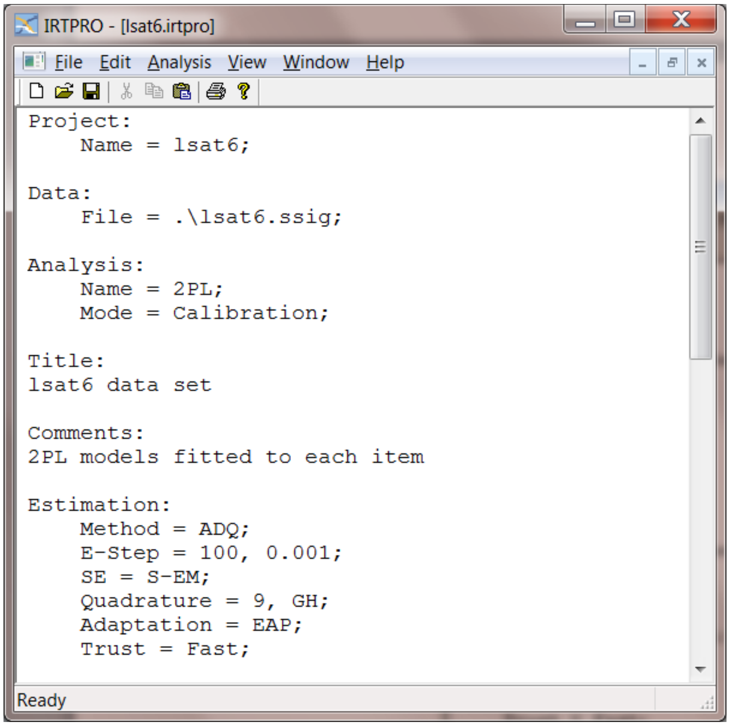


1.2 Adaptive Quadrature

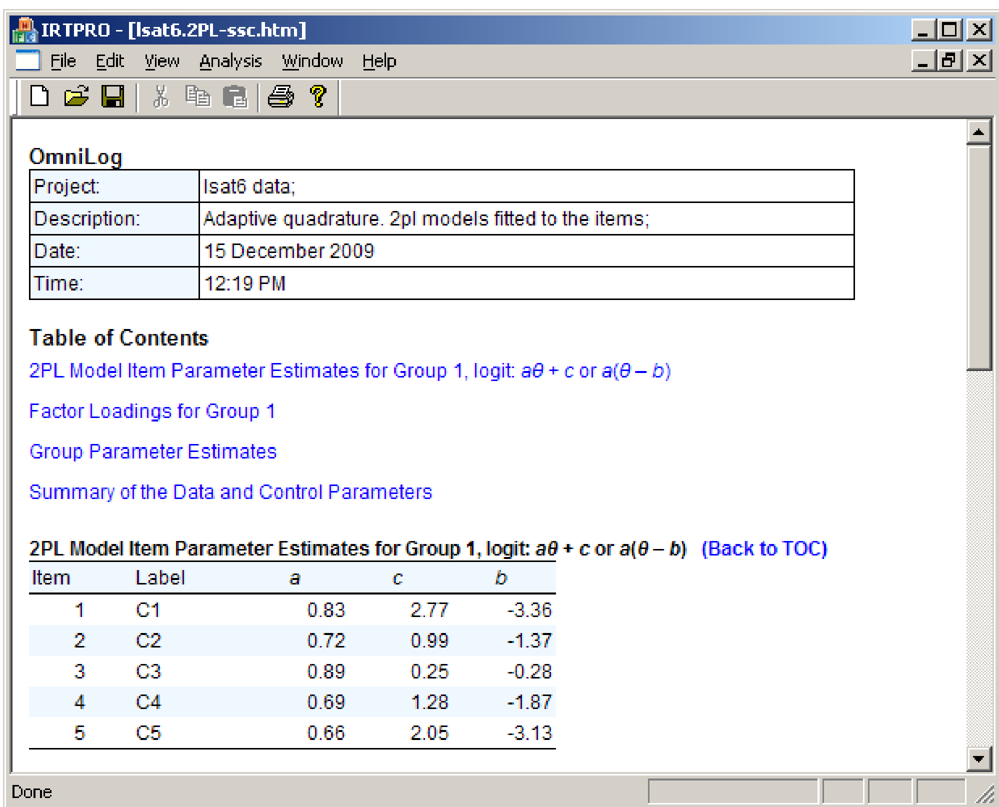
A problem with standard numerical quadrature as employed in the Bock-Aitkin procedure is that it has a fixed set of quadrature nodes for the posterior distribution of all persons. This often requires the use of a large number of quadrature points to calculate the log-likelihood and derivatives to an acceptable level of accuracy. To overcome this problem, IRTPRO also offers a numeric integration procedure called adaptive quadrature. The adaptive quadrature procedure uses the empirical Bayes means and covariances, updated at each iteration to essentially shift and scale the quadrature locations of each case (person) in order to place them under the peak of the corresponding integral.



The default adaptive quadrature settings are shown above. These settings can be changed or reset to the default values by clicking the **Default** button. Select the **OK** button when done. A portion of the updated syntax file is shown below.



Select the **Analysis**, **Run** option. The parameter estimates are shown below.



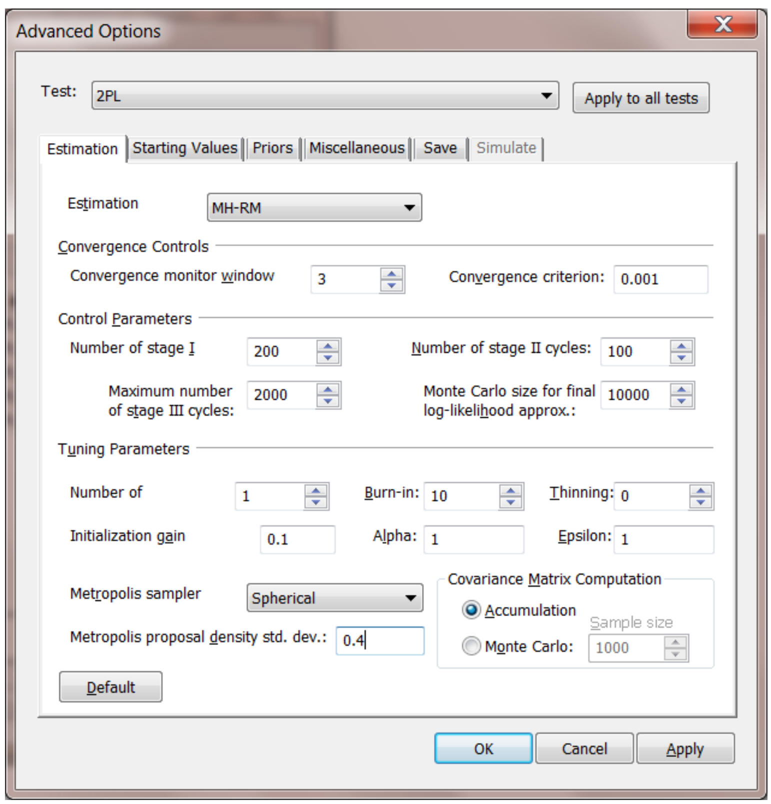
Project:	lsat6 data;
Description:	Adaptive quadrature. 2pl models fitted to the items;
Date:	15 December 2009
Time:	12:19 PM

Item	Label	*a*	*c*	*b*
1	C1	0.83	2.77	-3.36
2	C2	0.72	0.99	-1.37
3	C3	0.89	0.25	-0.28
4	C4	0.69	1.28	-1.87
5	C5	0.66	2.05	-3.13

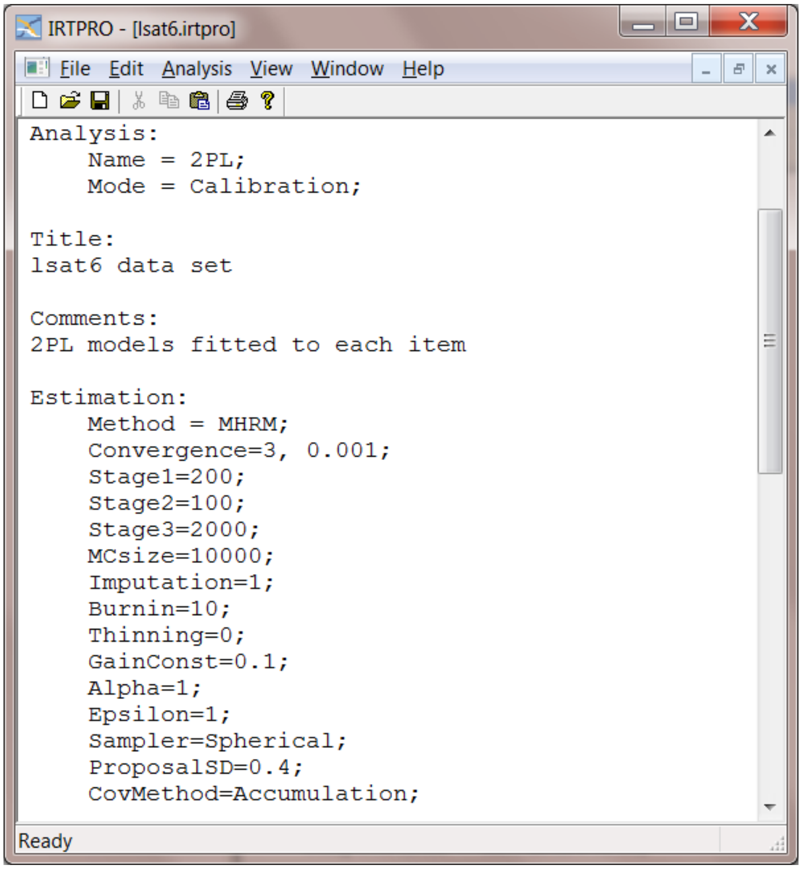
1.3 MH-RM

Li Cai (2010-b and 2010-c) proposed a Metropolis-Hastings Robbins-Monro (MH-RM) algorithm to address the "curse of dimensionality" that has plagued multidimensional IRT and high-dimensional latent structural equation modeling. The MH-RM algorithm performs favorably in comparative studies against established gold-standard methods such as Gaussian quadrature. The MH-RM algorithm is much more efficient than the MCEM algorithm in the use of Monte Carlo because the simulation size in MH-RM is fixed and usually small throughout the iterations. In addition, MH-RM produces an estimate of the parameter information matrix as a by-product that can be used subsequently for standard error estimation and goodness-of-fit testing.

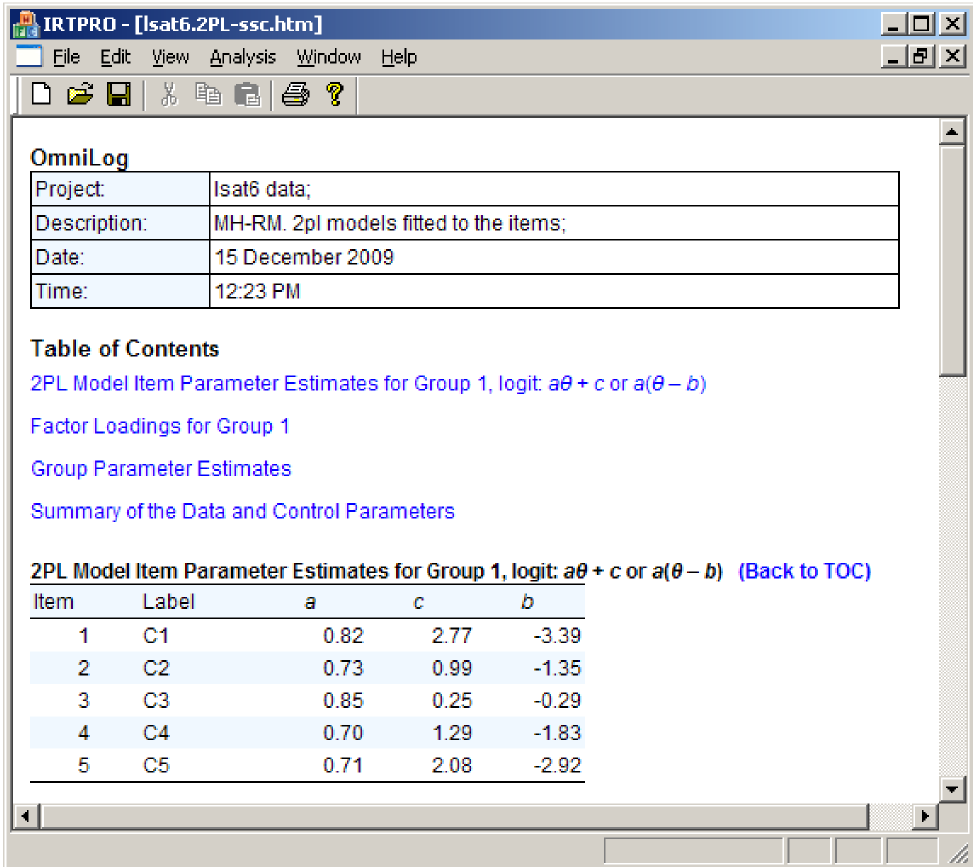
For practical data analysis, one can often achieve efficiency gains of several orders of magnitude over existing methods such as numerical quadrature if one uses MH-RM to estimate the parameters of the model. The MH-RM method is ideally suited for multi-dimensional analyses where the number of dimensions exceeds two or three.



A portion of the revised syntax file is shown below.



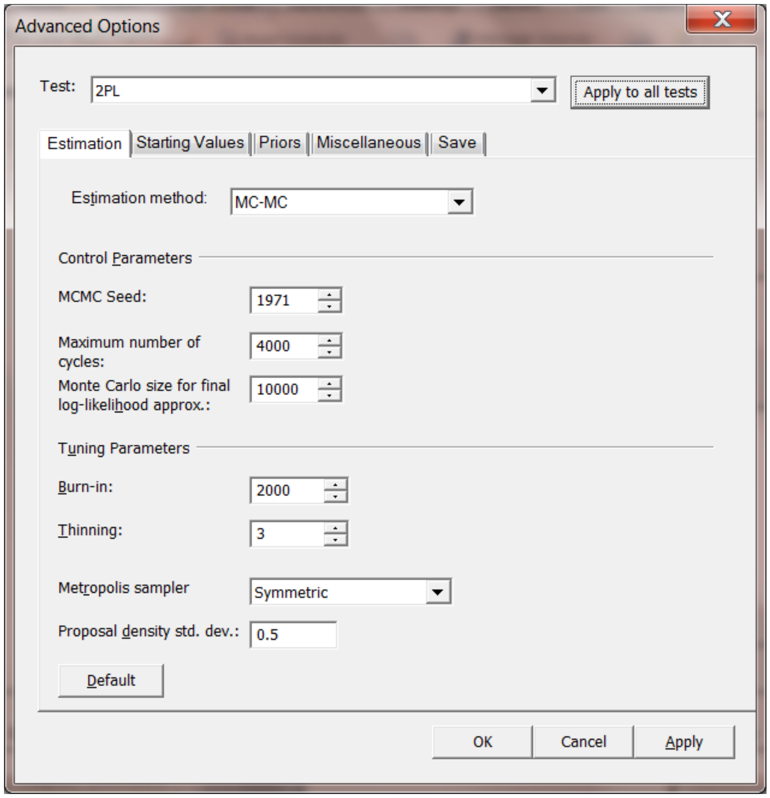
To run the 2PL model using the MH-RM method, select the **Analysis, Run** option. Some of the parameter estimates shown below differ a small amount from those obtained using the previously described estimation methods.



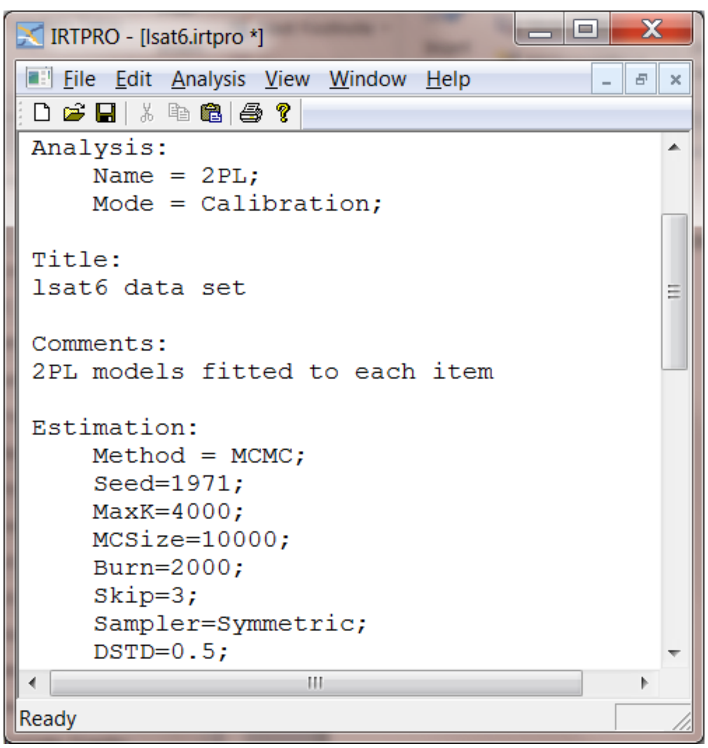
1.4 MCMC

The MCMC algorithm implemented in IRTPRO is based on the Patz-Junker's (1999-a, 1999-b) blocked Metropolis algorithm. The methodology developed in IRTPRO to impose parameter constraints and to implement multiple-group features enables the user to fit specialized IRT models using MCMC.

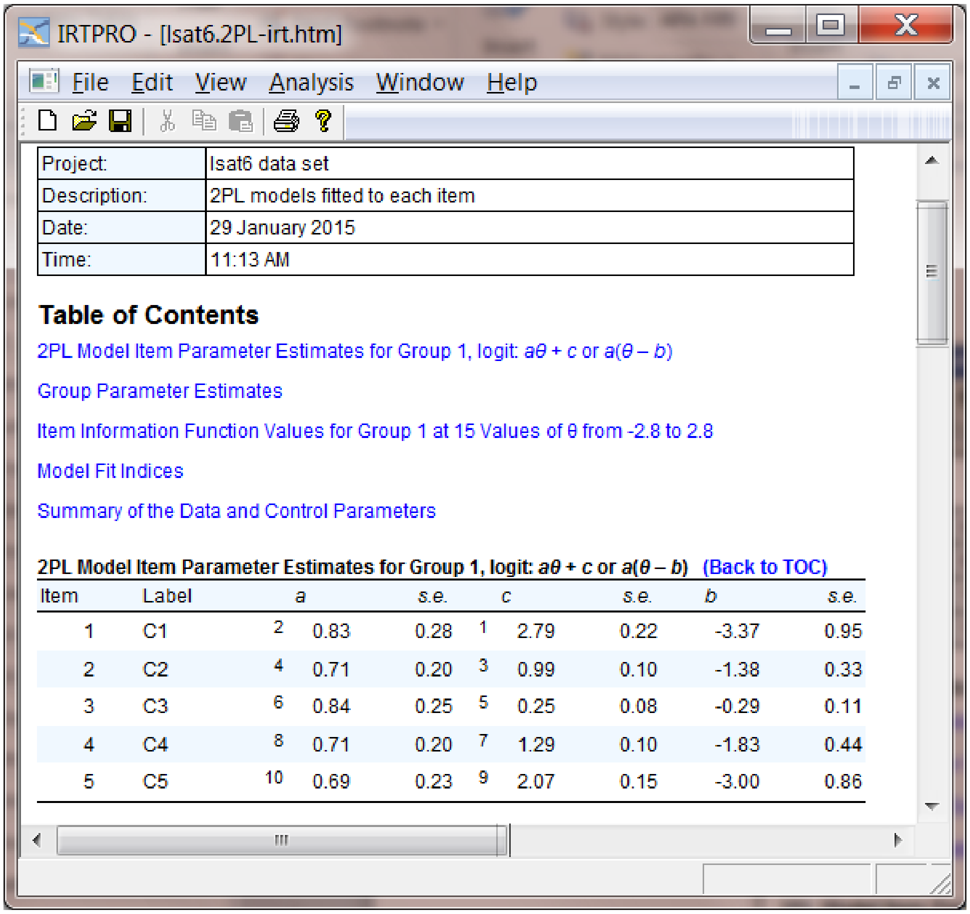
For practical data analysis, one can often achieve efficiency gains of several orders of magnitude over existing methods such as numerical quadrature if one uses MCMC to estimate the parameters of the model. The MCMC method is ideally suited for multi-dimensional analyses where the number of dimensions exceeds two or three.



A portion of the revised syntax file is shown below.



To run the 2PL model using the MCMC method, select the **Analysis, Run** option. Some of the parameter estimates shown below differ a small amount from those obtained using the previously described estimation methods.



IRTPRO - [lsat6.2PL-irt.htm]

File Edit View Analysis Window Help

Project:	lsat6 data set
Description:	2PL models fitted to each item
Date:	29 January 2015
Time:	11:13 AM

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2PL Model Item Parameter Estimates for Group 1, logit: $a\theta + c$ or $a(\theta - b)$

Group Parameter Estimates

Item Information Function Values for Group 1 at 15 Values of θ from -2.8 to 2.8

Model Fit Indices

Summary of the Data and Control Parameters

2PL Model Item Parameter Estimates for Group 1, logit: $a\theta + c$ or $a(\theta - b)$ (Back to TOC)

Item	Label		*a*	*s.e.*		*c*	*s.e.*	*b*	*s.e.*
1	C1	2	0.83	0.28	1	2.79	0.22	-3.37	0.95
2	C2	4	0.71	0.20	3	0.99	0.10	-1.38	0.33
3	C3	6	0.84	0.25	5	0.25	0.08	-0.29	0.11
4	C4	8	0.71	0.20	7	1.29	0.10	-1.83	0.44
5	C5	10	0.69	0.23	9	2.07	0.15	-3.00	0.86