

IRTEQ: Program Operation Manual

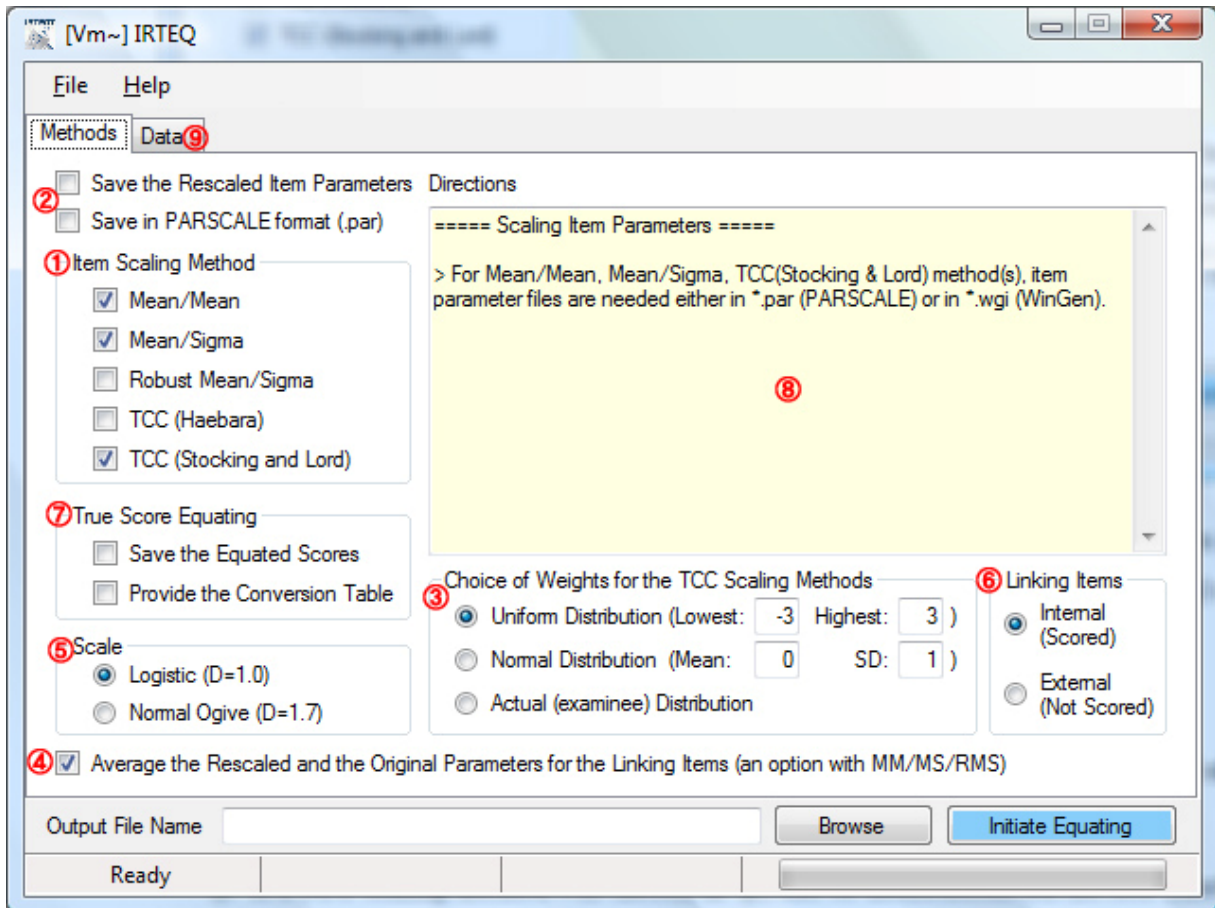
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I. IRTEQ Operation with Graphic User Interface

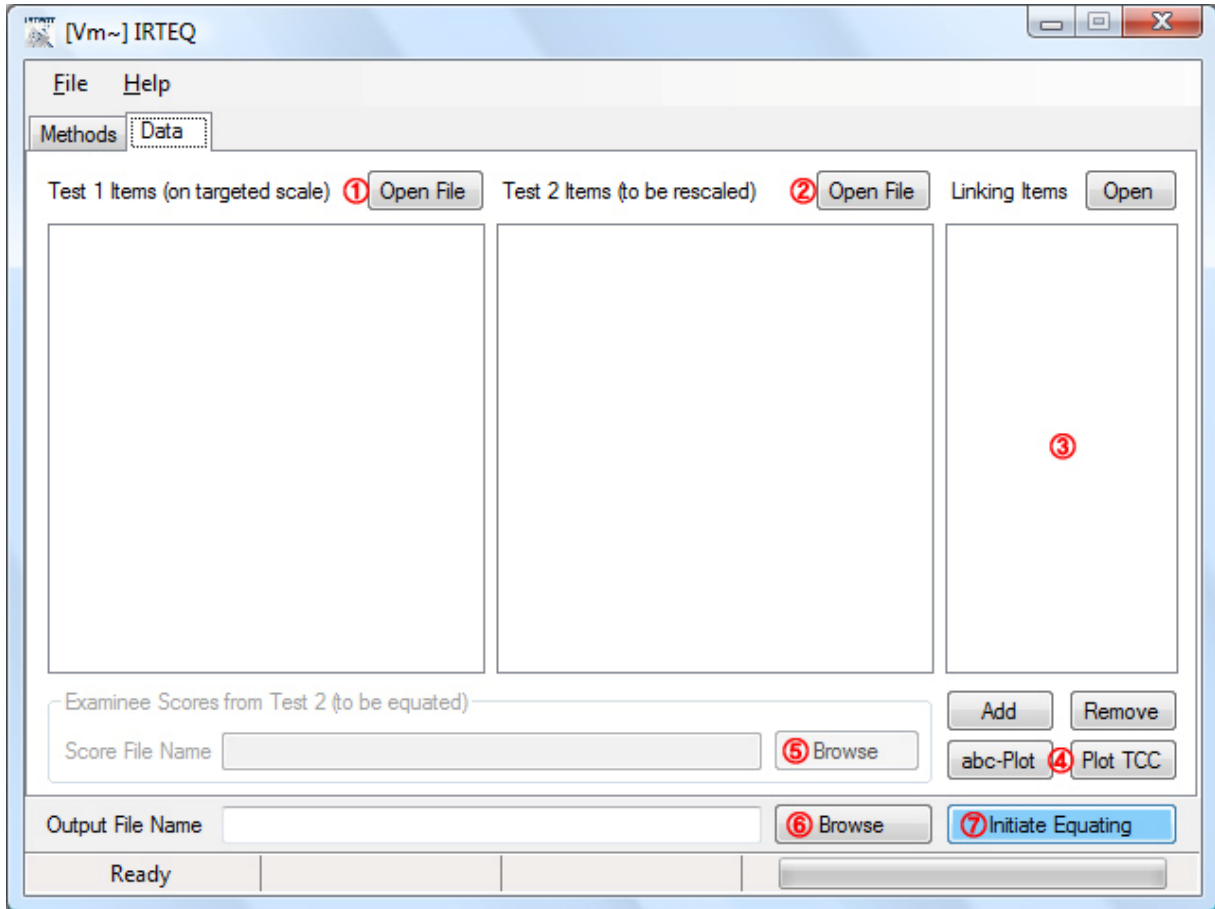
Step 1: Selection of Methods and Options



- ① Select at least one scaling method to use for rescaling test items.
- ② (Optional) Check the corresponding box if the rescaled items need to be saved either in WinGen format (.wgi) or in PARSCALE format (.par).
- ③ If a TCC scaling method was chosen in ①, one of distributions for the loss function should also be selected. Probably “Actual (examinee) distribution” is the most common in practice.
- ④ If MM, MS, and/or RMS was selected in ①, the rescaled item parameter estimates and the original parameter estimates for the linking items can be averaged for the final rescaled item parameter estimates by selecting this checkbox.

- ⑤ Either logistic or normal ogive must be selected to use the scaling factor 'D' (D=1.0 when 'logistic' is chosen, and D=1.7 when 'normal ogive' is chosen).
- ⑥ Specify whether or not the linking items are to be scored for the equated test scores. Sometimes the linking items are considered to be internal to the test, and then are considered part of the operational scoring. Other times, the linking items are considered to be external to the test, and they are not included in the operational scoring.
- ⑦ (Optional) Test scores for Test 2, which are in either WinGen (.wge) or PARSCALE format (.sco), can be equated to Test 1 by checking the box labeled 'Save Equated Scores.' The score conversion table for number correct scores can be saved by checking the box labeled 'Provide Conversion Table.' Note that in the current version of the software, when the c-parameter is included in the IRT model, test score to test score equating cannot be accomplished below the chance score (the sum of c parameter estimates for the test items) on the tests. There is a "patch" in Lord (1980) that can be programmed to handle this situation but it is not included in the current version of the software.
- ⑧ Review the options selected from ① to ⑦ and read the directions for the next step.
- ⑨ Click on the 'Data' tab to move to the next step – data entry and run.

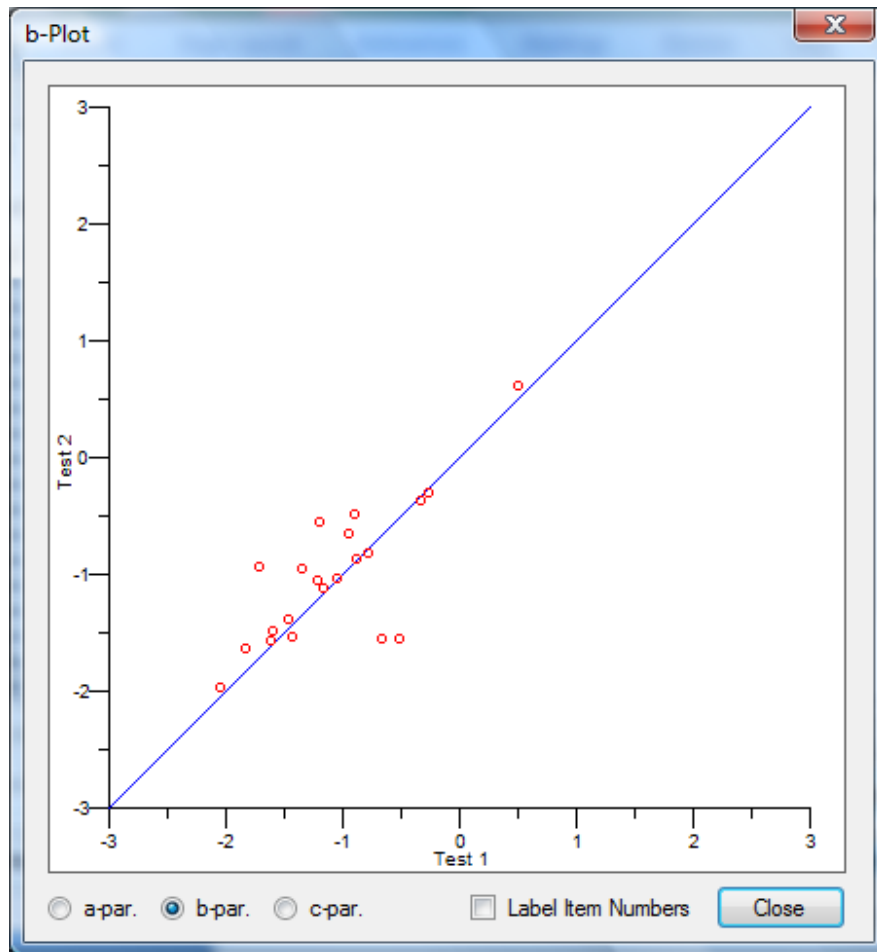
Step 2: Data Entry and Run



- ① Read in item parameter data for Test 1 (on targeted scale) by clicking on 'Open File.' The acceptable formats are either WinGen (.wge) format or PARSCALE (.par) format.
- ② Read in item parameter data for Test 2 (to be rescaled). Review the opened item data in the list box below.
- ③ A linking item list should either be specified or read in. To read in the linking item list file (.lkl – comma delimited file), click on 'Open.' To manually specify the linking items, match the linking items by highlighting on the linking items in both forms and then click the 'Add' button. After the match list of linking items is completed, it can be saved in the file *.lki (File>Save>Linking Item List). To remove a linking item pair, highlight the desired pair and click the 'Remove' button.

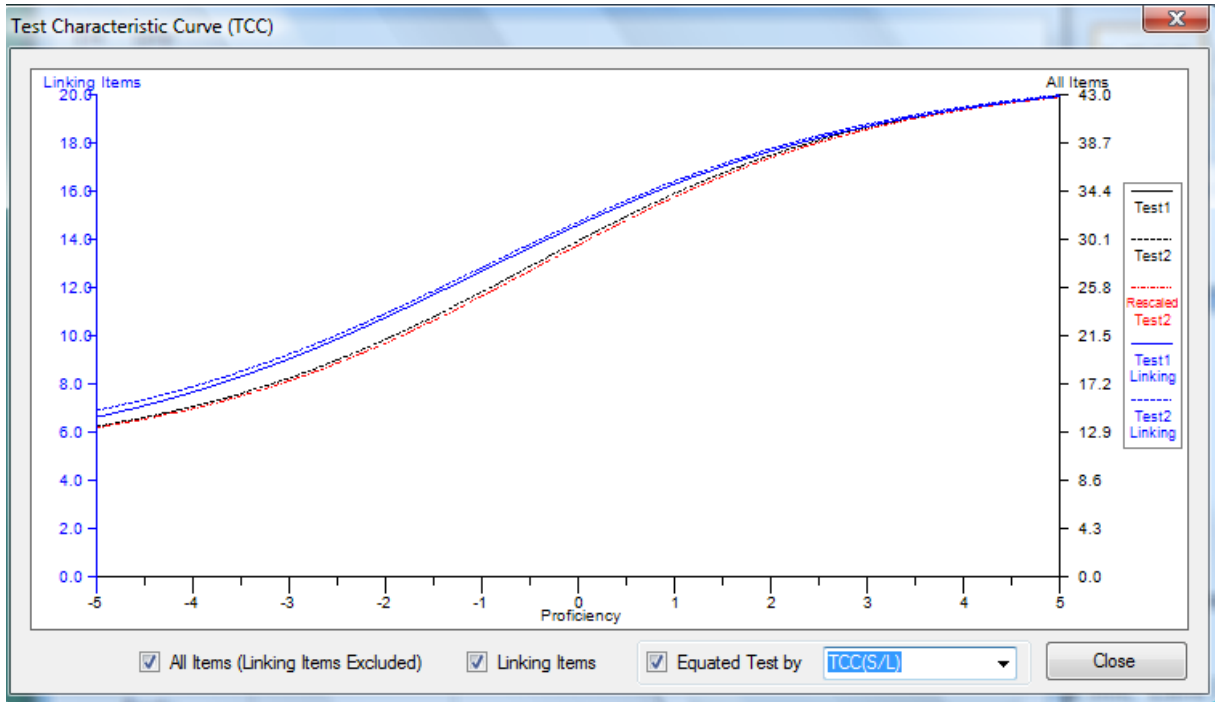
- ④ After test items for Tests 1 and 2 are successfully read in and a linking item list is completed, plots for comparing a-, b-, and c-parameter estimates across tests can be drawn by click on 'abc-plot.' TCC plots are also available, but only for the original tests and the linking item set (TCC for the rescaled Test 2 would be available after the whole equating procedure is done).
- ⑤ If either of the options 'Save Equated Scores' and/or 'Exact Distribution' for TCC methods were selected, score data should be read in. Otherwise, skip to the next procedure.
- ⑥ Specify the output filename.
- ⑦ Click on 'Execute Equating.' After the process is finished, the output file (.out) should be automatically opened. All options and methods selected can be saved in a syntax file at 'File>Save>Syntax File' for later use.
- ⑧ The TCC for the rescaled test form can be shown by clicking on the button labeled 'Plot TCC' (④).

abc-Plot



- Plots of a-, b-, and c-parameters are available only after test item data (for both tests) and the linking item list are completely read-in or specified.
- The items in the plot can be numbered by checking the box titled 'Label Item Numbers.' When some of linking items are polytomous, the order of the b-parameter will be displayed in parentheses following the item number.
- Note that the scales of the X and Y axes change according to the choice of a-, b-, and c-parameters.

Test Characteristic Curve (TCC) Plot



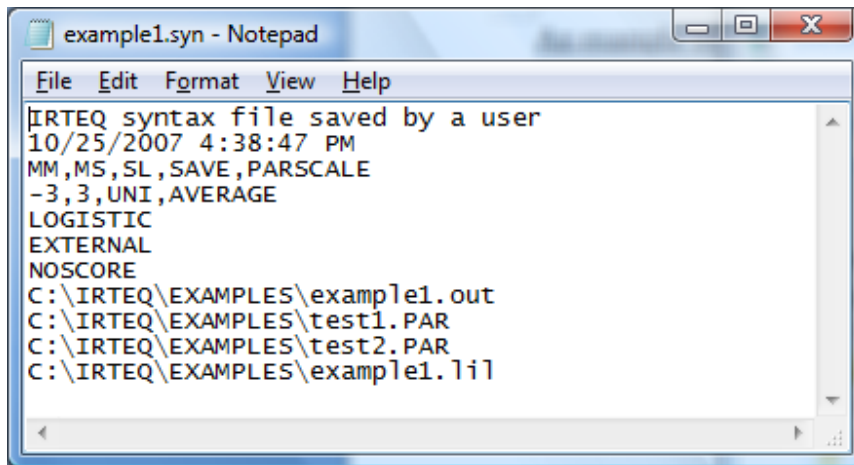
- The TCCs for Tests 1 and 2 (black curves) are available after the test item data (.wgi or .par) are successfully read in. The TCC will be drawn differently according to the choice of linking item type (internal or external). The scale for the TCC with all items is displayed on the right side of the plot.
- The TCCs for the linking items (blue curves) are available after test item data (.wgi or .par) are successfully read in and the linking item list is completed. The scale for the TCC with the linking items is displayed on the left side of the plot.
- The TCC for the rescaled Test 2 (red dotted curve) is available only after the whole equating process is complete. Different TCCs for the rescaled Test 2 are shown according to the choice of scaling method. Users can choose a TCC with Test 2 rescaled by different scaling methods in the combo box (the small, white drop-down box).
- All available TCCs are displayed on the same plot by default. Unwanted TCCs can be hidden by unchecking the boxes along the bottom.

II. IRTEQ with Syntax and Cue Files

- A syntax file can be opened at File>Open>Syntax File. There is still a chance for the options to be changed by a user before clicking on the 'Execute Equating' button.
- A syntax file can be opened at File>Open and automatically run at Run>Syntax.

Line	Description	Command/Option
1	Title #1 (e.g., "IRTEQ syntax file")	[Text]
2	Title #2 (e.g., date and time)	[Text]
3	Scaling methods and options	MM, MS, RMS, HA, SL, SAVE, PARSCALE
4	TCC scaling options / average option	[min], [max], (UNI, NORM, or ACTUAL), [mean (only with NORM)], [SD (only with NORM)], (AVERAGE or NOAVERAGE)
5	Scale	LOGISTIC or NORMAL
6	Scoring linking items	INTERNAL or EXTERNAL
7	Equating Options	CONVERSION, EQUATE (otherwise NOSCORE)
8	Full path and filename for an output file	*.eqt
9	Full path and filename of test form 1	*.wgi or *.par
10	Full path and filename of test form 2	*.wgi or *.par
11	Full path and filename of linking item	*.lki
12	Full path and filename or score data (only if EXACT and/or EQUATE options are used)	*.wge or *.sco

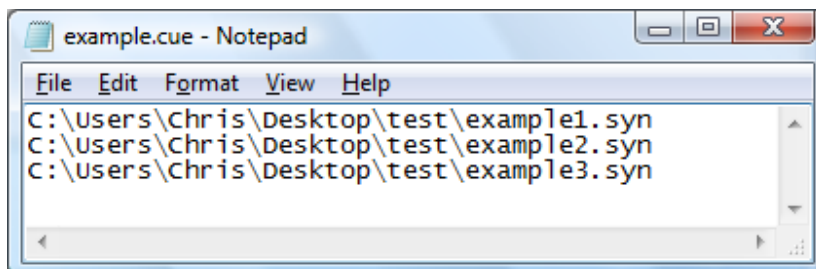
Sample syntax file



```
example1.syn - Notepad
File Edit Format View Help
IRTEQ syntax file saved by a user
10/25/2007 4:38:47 PM
MM,MS,SL,SAVE,PARSCALE
-3,3,UNI,AVERAGE
LOGISTIC
EXTERNAL
NOSCORE
C:\IRTEQ\EXAMPLES\example1.out
C:\IRTEQ\EXAMPLES\test1.PAR
C:\IRTEQ\EXAMPLES\test2.PAR
C:\IRTEQ\EXAMPLES\example1.lil
```

- A series of syntax files can be run with a cue file at File>Open and Run>Cue. A cue file is a list of filenames for syntax files (which is same as a batch file in DOS system).

Sample cue file



```
example.cue - Notepad
File Edit Format View Help
C:\Users\Chris\Desktop\test\example1.syn
C:\Users\Chris\Desktop\test\example2.syn
C:\Users\Chris\Desktop\test\example3.syn
```

APPENDIX

Loss Functions for TCC Scaling Methods in IRTEQ

For TCC (Haebara, 1980) Scaling Method, a loss function at a score point θ_i is defined as

$$L(\theta_i) = \sum_{j=1}^m [p_{ij}(\theta_i, a_{X_{Lj}}, b_{X_{Lj}}, c_{X_{Lj}}) - p_{ij}(\theta_i, a_{Y_{Lj}}^*, b_{Y_{Lj}}^*, c_{Y_{Lj}})]^2, \quad (1)$$

where

$$a_{Y_{Lj}}^* = \frac{a_{Y_{Lj}}}{A}, \quad (2)$$

and

$$b_{Y_{Lj}}^* = Ab_{Y_{Lj}} + B. \quad (3)$$

In Equation (1), $a_{X_{Lj}}$, $b_{X_{Lj}}$, and $c_{X_{Lj}}$ are discrimination, difficulty, and pseudo-guessing parameters, respectively, for the j -th linking item in test form X.

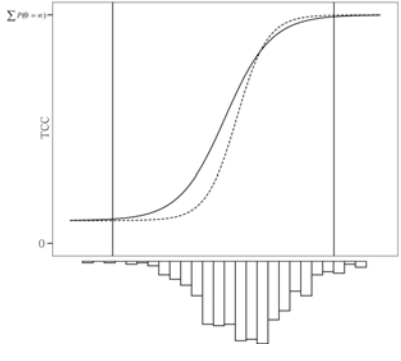
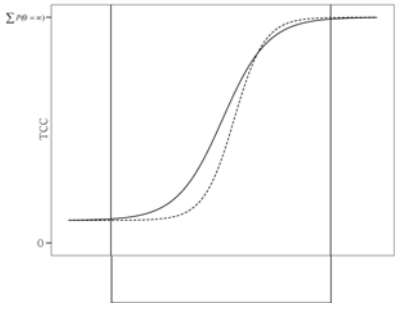
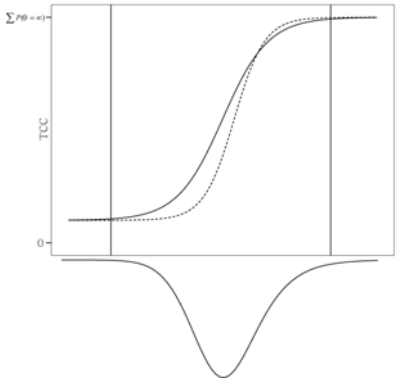
For Stocking and Lord's (1983) Scaling Method, a loss function at a score point θ_i is defined as

$$L(\theta_i) = \left[\sum_{j=1}^m p_{ij}(\theta_i, a_{X_{Lj}}, b_{X_{Lj}}, c_{X_{Lj}}) - \sum_{j=1}^m p_{ij}(\theta_i, a_{Y_{Lj}}^*, b_{Y_{Lj}}^*, c_{Y_{Lj}}) \right]^2. \quad (4)$$

To evaluate loss functions of both Haebara (1980) and Stocking and Lord (1983) methods, IRTEQ provides users options to choose from various distributions of θ . Transforming coefficients A and B that minimize the loss functions across θ 's from a distribution chosen are found by IRTEQ. See Table 1 for details.

Table 1

Three Possible Distributions to Use in IRTEQ to Specify the Weighted Loss Functions (Actual, Uniform, and Normal)

Distribution	Integral of Loss Function	Minimization
Actual		$\text{Min}[\sum_{i=1}^N L(\theta_i)],$ <p>where N is the number of examinees, and θ_i is the proficiency of the i-th examinee.</p>
Uniform		$\text{Min}[\sum_{i=1}^Q L(\theta_i)],$ <p>where Q is the number of quadrature points within a certain range on the theta scale, and θ_i is the theta value at the i-th quadrature point.</p>
Normal		$\text{Min}[\sum_{i=1}^Q L(\theta_i) \varphi_{\mu, \sigma^2}(\theta_i)]$ <p>where the φ_{μ, σ^2} is the probability density function (PDF) for a normal distribution.</p>