Rasch One Parameter Item Analysis

Item Response Theory (IRT) is another theoretical view of subject responses to items on a test. IRT suggests that items may posess one or more characteristics (parameters) that may be estimated. In the theory developed by George Rasch, one parameter, item difficulty, is estimated (in addition to the estimate of individual subject "ability" parameters.) Utilizing maximum-liklihood methods and log difficulty and log ability parameter estimates, the Rasch method attempts to estimate subject and item parameters that are "independent" of one another. This is unlike Classical theory in which the item difficulty (proportion of subects passing an item) is directly a function of the ability of the subjects sampled. IRT is sometimes also considered to be a "Latent Trait Theory" due to the assumption that all of the items are measures of the same underlying "trait". Several tests of the "fit" of the item responses to this assumption are typically included in programs to estimate Rasch parameters. Other IRT procedures posit two or three parameters, the others being the "slope" and the "chance" parameters. The slope is the rate at which the probability of getting an item correct increases with equal units of increase in subject ability. The chance parameter is the probability of obtaining the item correct by chance alone. In the Rasch model, the chance probability is assumed to be zero and the slope parameter assumed to be equal for all items.
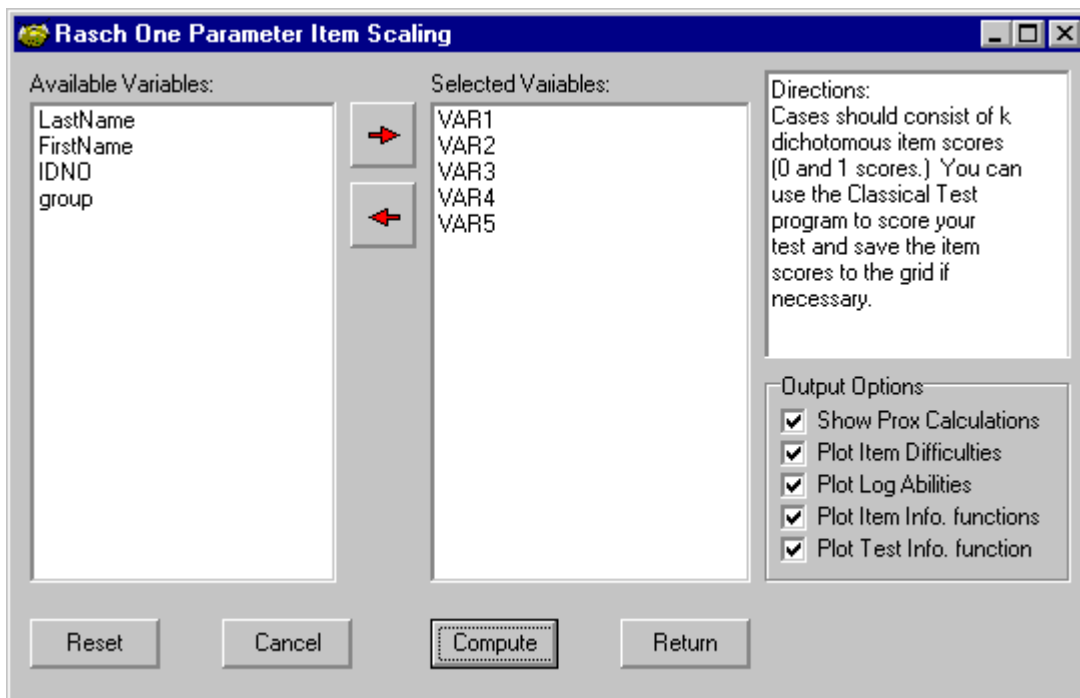

Figure 1   Rasch Item Analysis Dialog

Shown below is a sample of output from a test analyzed by the Rasch model. The model cannot makeability estimates for subjects that miss all items or get all items correct so they are screened out. Parameters estimated are given in log units. Also shown is one of the item information function curve plots. Each item provides the maximum discrimination (information) at that point where the log ability of the subject is approximately the same as the log difficulty of the item. In examining the output you will note that item 1 does not appear to fit the assumptions of the Rasch model as measured by the chi-square statistic.
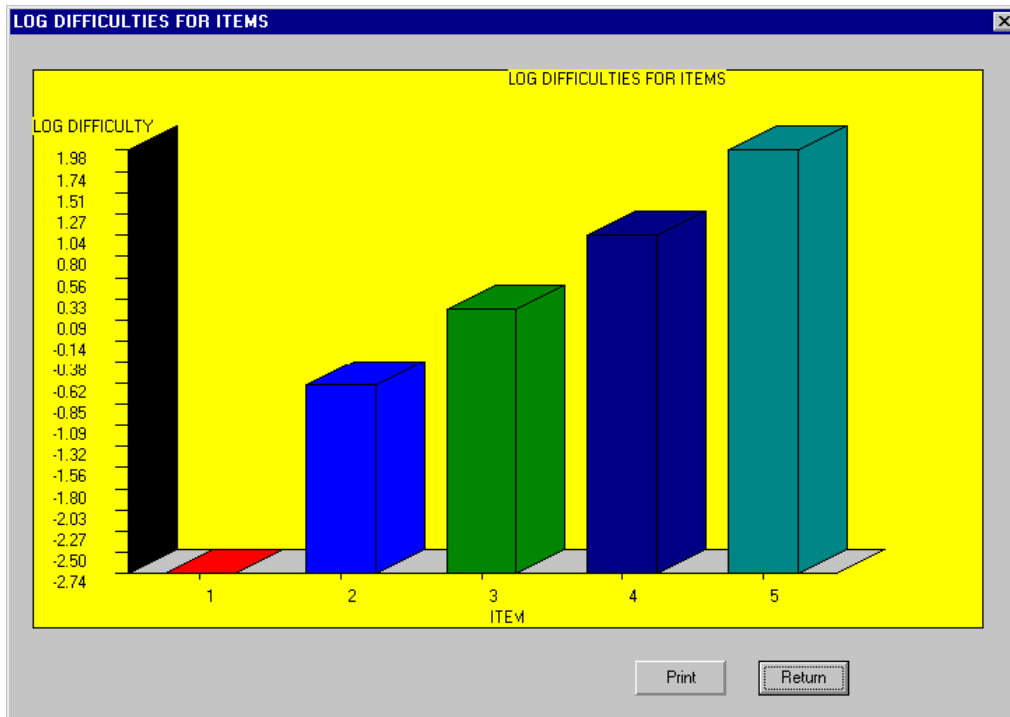
Figure 2   Rasch Item Log Difficulty Estimate Plot
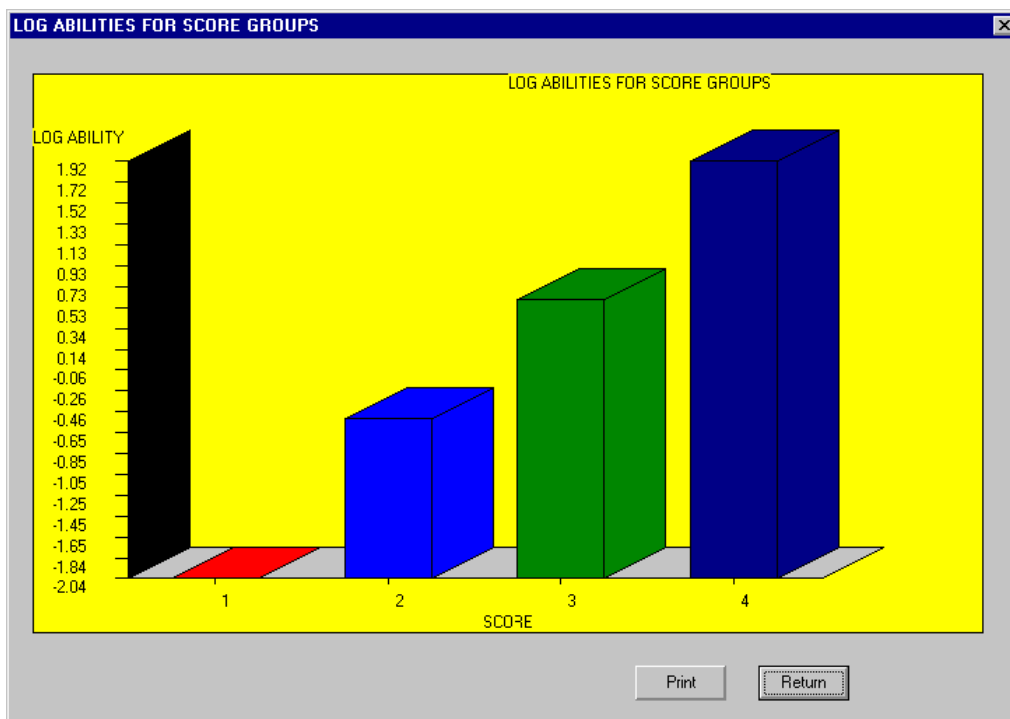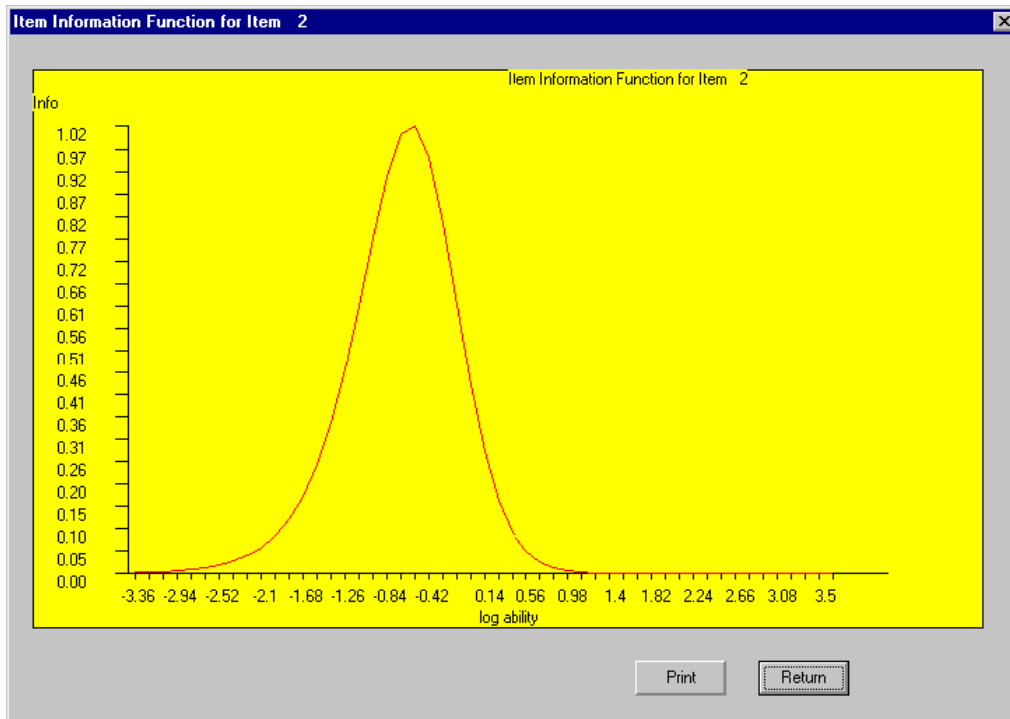

Figure 3   Rasch Log Score Estimates
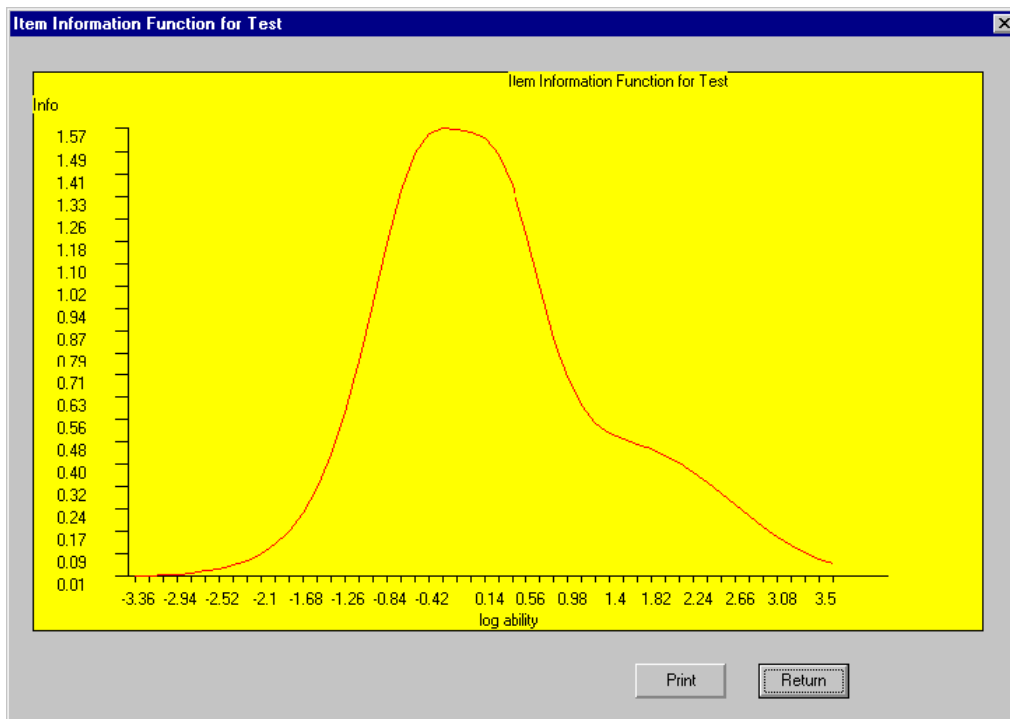
Figure 4   A Rasch Item Characteristic Curve

Figure 5   A Rasch Text Information Curve

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Rasch One-Parameter Logistic Test Scaling (Item Response Theory)
Written by William G. Miller
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```
case   1 eliminated.  Total score was   5
Case   2 Total Score :=   4 Item scores 1 1 1 1 0
Case   3 Total Score :=   3 Item scores 1 1 1 0 0
Case   4 Total Score :=   2 Item scores 1 1 0 0 0
Case   5 Total Score :=   1 Item scores 1 0 0 0 0
case   6 eliminated.  Total score was   0

Case   7 Total Score :=   1 Item scores 1 0 0 0 0
Case   8 Total Score :=   2 Item scores 1 1 0 0 0
Case   9 Total Score :=   3 Item scores 1 1 1 0 0
Case  10 Total Score :=   4 Item scores 1 1 1 1 0
case  11 eliminated.  Total score was   5
Case  12 Total Score :=   3 Item scores 1 0 1 0 1
Case  13 Total Score :=   3 Item scores 0 1 1 1 0
Case  14 Total Score :=   4 Item scores 1 1 1 0 1
Case  15 Total Score :=   4 Item scores 1 1 0 1 1
Case  16 Total Score :=   2 Item scores 1 0 0 1 0

Total number of score groups :=    4

Matrix of Item Failures in Score Groups
   Score Group   1   2   3   4      Total
ITEM

   1             0   0   1   0       1
   2             2   1   1   0       4
   3             2   3   0   1       6
   4             2   2   3   1       8
   5             2   3   3   2      10
Total            2   3   4   4      13
```

```
Item Log Odds Deviation Squared Deviation
  1   -2.48    -2.13        4.54
  2   -0.81    -0.46        0.21

  3   -0.15     0.20        0.04
  4    0.47     0.83        0.68
  5    1.20     1.56        2.43
Score Frequency Log Odds Freq.x Log  Freq.x Log Odds Squared
  1      2       -1.39       -2.77         3.84
  2      3       -0.41       -1.22         0.49
  3      4        0.41        1.62         0.66
  4      4        1.39        5.55         7.69
```

```
Prox values and Standard Errors

Item      Scale Value       Standard Error
  1       -2.730             1.334
  2       -0.584             0.770

  3        0.258             0.713
  4        1.058             0.731
  5        1.999             0.844
Y expansion factor :=   1.2821

Score     Scale Value       Standard Error
  1       -1.910            1.540
```

```
   2     -0.559              1.258
   3      0.559              1.258
   4      1.910              1.540
X expansion factor =   1.3778
Maximum Likelihood Iteration Number  0
Maximum Likelihood Iteration Number  1
Maximum Likelihood Iteration Number  2
Maximum Likelihood Iteration Number  3


Maximum Likelihood Estimates

Item  Log Difficulty
   1      -2.74
   2      -0.64
   3       0.21
   4       1.04
   5       1.98


Score   Log Ability
   1      -2.04
   2      -0.54
   3       0.60
   4       1.92


Goodness of Fit Test for Each Item
Item  Chi-Squared  Degrees of  Probability
No.   Value        Freedom     of Larger Value
   1     29.78        9           0.0005
   2      8.06        9           0.5283
   3     10.42        9           0.3177
   4     12.48        9           0.1875

   5      9.00        9           0.4371


Item Data Summary
ITEM  PT.BIS.R.  BIS.R.   SLOPE    PASSED   FAILED   RASCH DIFF
   1   -0.064    -0.117   -0.12    12.00      1       -2.739
   2    0.648     0.850    1.61     9.00      4       -0.644
   3    0.679     0.852    1.63     7.00      6        0.207
   4    0.475     0.605    0.76     5.00      8        1.038
   5    0.469     0.649    0.85     3.00     10        1.981
```