EPSY 5221 jMetrik IRT Lab

In this assignment we will conduct IRT analyses in jMetrik. We will again use the sample Exam 1 data including 5948 students who completed 56 multiple-choice items, scored dichotomously. We will also use the Liking Science data including 75 children who rated 25 items on a 3-point scale. For each of the following tasks, provide a written response and the corresponding displays as requested from the jMetrik output.

Coding the LIKING SCIENCE response data:

For the Rasch analysis, the item data must be recoded for the Liking Science responses.

1. In the [**Transform**] tab 🡪 select [Advanced Item Scoring]
2. Send all items to the right using the [>>] tool
3. In the *Option* and *Score* columns, enter 0 and 0, 1 and 1, 2 and 2, respectively. This fixes the item codes to their original values. The Rasch model will then use a partial-credit model, where Dislike receives no credit (0), Neutral receives partial credit (1), and Like receives full credit (2). This preserves the rating scale values so the Rasch model works.

Repeat tasks 1-7 below for both Exam-1 and Liking-Science data. Each of these tasks is worth 3 points for each data set (6 points in total per task; except question 8 which is for Exam 1 only). The lab is worth 45 points total.

1. Report the mean score, standard deviation, and maximum and minimum scores for the total test. These descriptives should be for the IRT Theta scores, not the raw or observed scores.
	1. Select the appropriate data table:
	2. [**Analyze**] 🡪 [Rasch Models].
		1. In the **Global** tab: [for Exam 1: do not check “Ignore missing data]

 [for Liking Science: check “Ignore missing data]

* + 1. In the **Item** tab: [Save: Item Estimates, with a name like “Exam1Stats” or “LikingStats”]
		2. In the **Person** tab: [Save: Person Estimates] and [Save: Person Fit Statistics]
		3. Run
	1. Select the appropriate data table:

[**Analyze**] 🡪 [Descriptives] and select “theta” from the variables.

This will give you summary stats on the theta scores.

1. Report Guttman reliability for the raw sum score and the reliability for the Person scores (theta). Show how this is computed, step-by-step, using true variance (adjusted variance) and observed variance with our theoretical definition of reliability. Interpret the reliability value.
	1. Guttman reliability comes from the item analysis summary table you obtained in Lab 1.
	2. The adjusted variance and observed variance come from the Rasch table you obtained in 1.b above. Remember: $Reliability= \frac{True Variance}{Observed Variance}$.
2. Among the first 25 students, which student is the lowest ability student? What is his/her ability score and standard error? Does this student fit the model?
	1. You will find this information by looking in the data file in the jMetrik data window.
	2. Remember, ability is reported as Theta in the data file. Fit is measured by WMS (infit); these values should be less than 1.5.
3. What is the most difficult item? What is the location statistic and standard error for this item? Provide an interpretation for this value – how do you communicate the meaning of the item “difficulty” value? Does this item fit the model?
	1. You will find this information in two places:
		1. The Rasch table produced in 1.b above (in the output).
		2. The Item Stats table saved in jMetrik.
	2. The item location is measured by the b-parameter, the item location on the theta scale.
	3. Fit is measured in the same way with WMS and UMS.
4. Which items, if any, do not fit the model? How do you know? What does it mean to fit or not fit the model? Consider all the items in the Item Stats tables for Exam 1 and Liking Science and review item fit.
5. Compare the Item Characteristic Curves (ICCs) and Item Information Curves (IICs) from Exam 1 items: 1, 2, 3, 27, 32; and Liking Science items: 1, 2, 3, 4, 5. Discuss the differences you see in these curves (for each test separately), given the parameter(s) estimated.
	1. Select one ICC graphic. Mark the location of the curve (the b parameter for Exam 1 and the steps for Liking Science). What does this parameter tell us about this item?
	2. For each item, you will see the ICC always increasing across theta and the IIC which is normally distributed and centered at the location of the item (b-parameter).
	3. To create the ICCs and IICs:
		1. Select the ItemStats data table
		2. [Graph] 🡪 [IRT Plot]
		3. Select all the items.
		4. In the Item options, select [Characteristic Curve] and [Information Function]
		5. In the Person options, select NO options
		6. Curve Type: Category Probability
6. Describe the Item Map: Where are items located on the theta scale compared to students? Do students have more or less ability compared to the difficulty of the items? This is like asking: are the items written at the level of student abilities?
	1. Select the sample exam data set.
	2. [Graph] 🡪 [Item Map]
	3. Select “theta” at the top of the file – this is for person locations.
	4. Select the item stats data file for [Item Parameter Table] – this is for item locations.
	5. You can give the graph a title: Exam 1 Item Map or Liking Science Item Map.
	6. Run
7. EXAM 1 ONLY: Estimate the NonParametric Curves of all Exam 1 items. Examine the curves for Exam 1 item 27. What is your interpretation of this result for Item 27? What does the Rasch analysis of this item suggest?
	1. Select the Exam 1 data set.
	2. [Analyze] 🡪 [Nonparametric Curves]
	3. Select all of the items for analysis, click [Run].
	4. Examine the curve for Item 27.

DESCRIPTIVE STATISTICS

EXAM1

Theta

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 Statistic Value

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N 5948.0000

Valid N 5948.0000

Min -4.2954

Max 5.4998

Mean 0.2485

Std. Dev. 1.0227

Skewness 0.2012

Kurtosis -0.0774

First Quartile -0.5659

Median 0.2494

Third Quartile 0.9325

IQR 1.4985

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DESCRIPTIVE STATISTICS

LIKINGSCIENCE

Theta

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 Statistic Value

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N 75.0000

Valid N 75.0000

Min -1.6536

Max 5.9251

Mean 0.8111

Std. Dev. 1.3519

Skewness 1.1745

Kurtosis 2.4481

First Quartile -0.0522

Median 0.5442

Third Quartile 1.4854

IQR 1.5376

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EXAM 1 RESULTS

SCALE QUALITY STATISTICS

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Statistic Items Persons

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Observed Variance 0.5704 1.0413

Observed Std. Dev. 0.7552 1.0204

Mean Square Error 0.0009 0.1013

Root MSE 0.0301 0.3182

Adjusted Variance 0.5695 0.9400

Adjusted Std. Dev. 0.7546 0.9695

Separation Index 25.0347 3.0467

Number of Strata 33.7130 4.3956

Reliability 0.9984 0.9027

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LIKING SCIENCE RESULTS

SCALE QUALITY STATISTICS

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Statistic Items Persons

--------------------------------------------------

Observed Variance 1.5208 1.4997

Observed Std. Dev. 1.2332 1.2246

Mean Square Error 0.0539 0.1597

Root MSE 0.2322 0.3996

Adjusted Variance 1.4669 1.3400

Adjusted Std. Dev. 1.2111 1.1576

Separation Index 5.2153 2.8970

Number of Strata 7.2871 4.1960

Reliability 0.9645 0.8935

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**EXAM 1**

**First 25 Persons with Rasch Analysis Results**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **id** | **vsum** | **theta** | **stderr** | **extreme** | **wms** | **stdwms** | **ums** | **stdums** |
| 1 | 35 | 0.5791 | 0.2909 | No | 0.9655 | -0.3225 | 0.9673 | -0.1817 |
| 2 | 30 | 0.1688 | 0.2836 | No | 0.9716 | -0.3183 | 0.9225 | -0.6631 |
| 3 | 32 | 0.3305 | 0.2854 | No | 0.9892 | -0.0972 | 1.0032 | 0.0668 |
| 4 | 23 | -0.3975 | 0.2881 | No | 1.0675 | 0.7067 | 1.0501 | 0.4350 |
| 5 | 35 | 0.5791 | 0.2909 | No | 0.9105 | -0.9074 | 0.8463 | -1.0806 |
| 6 | 15 | -1.1202 | 0.3186 | No | 1.1630 | 1.0469 | 1.2873 | 1.3175 |
| 7 | 33 | 0.4123 | 0.2868 | No | 0.9352 | -0.7117 | 0.9204 | -0.5949 |
| 8 | 23 | -0.3975 | 0.2881 | No | 1.0855 | 0.8812 | 1.1079 | 0.8730 |
| 9 | 21 | -0.5659 | 0.2927 | No | 1.0586 | 0.5656 | 1.2690 | 1.8159 |
| 10 | 19 | -0.7408 | 0.2990 | No | 0.9847 | -0.0856 | 1.0078 | 0.1022 |
| 11 | 14 | -1.2239 | 0.3255 | No | 1.2772 | 1.5895 | 1.4576 | 1.8400 |
| 13 | 33 | 0.4123 | 0.2868 | No | 0.8831 | -1.3324 | 0.8336 | -1.3337 |
| 14 | 37 | 0.7517 | 0.2969 | No | 0.9122 | -0.7814 | 0.8464 | -0.9379 |
| 15 | 32 | 0.3305 | 0.2854 | No | 1.0335 | 0.4130 | 1.0054 | 0.0847 |
| 16 | 37 | 0.7517 | 0.2969 | No | 0.9301 | -0.6106 | 0.8801 | -0.7107 |
| 17 | 34 | 0.4951 | 0.2887 | No | 1.0269 | 0.3171 | 1.0772 | 0.6005 |
| 18 | 40 | 1.0270 | 0.3100 | No | 0.9147 | -0.6010 | 0.9044 | -0.4254 |
| 19 | 22 | -0.4810 | 0.2902 | No | 1.1478 | 1.4038 | 1.1482 | 1.1141 |
| 20 | 43 | 1.3331 | 0.3302 | No | 0.9893 | -0.0058 | 0.8742 | -0.4440 |
| 21 | 21 | -0.5659 | 0.2927 | No | 1.1933 | 1.7113 | 1.2185 | 1.5041 |
| 22 | 33 | 0.4123 | 0.2868 | No | 1.0504 | 0.5848 | 1.1367 | 1.0630 |
| 23 | 19 | -0.7408 | 0.2990 | No | 1.0279 | 0.2674 | 0.9804 | -0.0705 |
| 24 | 34 | 0.4951 | 0.2887 | No | 1.0174 | 0.2168 | 1.0034 | 0.0700 |
| 25 | 40 | 1.0270 | 0.3100 | No | 0.9779 | -0.1188 | 0.9400 | -0.2384 |
| 26 | 26 | -0.1524 | 0.2841 | No | 0.9168 | -0.9559 | 0.8797 | -1.0816 |

**LIKING SCIENCE**

**First 25 Persons with Rasch Analysis Results**

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **id** | **vsum** | **theta** | **stderr** | **extreme** | **wms** | **stdwms** | **ums** | **stdums** |
| 1 | 29 | 0.4928 | 0.3469 | No | 0.9575 | -0.0654 | 0.8411 | -0.3043 |
| 2 | 49 | 5.9902 | 1.8435 | Maximum | 0.0298 | -0.9922 | 0.0122 | -1.1611 |
| 3 | 33 | 0.9932 | 0.3618 | No | 0.4644 | -2.2833 | 0.4212 | -1.4353 |
| 4 | 26 | 0.1394 | 0.3402 | No | 0.7289 | -1.0341 | 0.6626 | -0.9927 |
| 5 | 18 | -0.7761 | 0.3418 | No | 0.8119 | -0.7034 | 1.4071 | 1.2126 |
| 6 | 23 | -0.2040 | 0.3371 | No | 1.6106 | 2.0819 | 2.5196 | 3.4495 |
| 7 | 43 | 2.6331 | 0.4796 | No | 1.8488 | 1.9359 | 1.1817 | 0.5038 |
| 8 | 32 | 0.8640 | 0.3573 | No | 1.0107 | 0.1317 | 0.8491 | -0.2070 |
| 9 | 23 | -0.2040 | 0.3371 | No | 1.4249 | 1.5384 | 2.0087 | 2.5325 |
| 10 | 27 | 0.2557 | 0.3420 | No | 0.7379 | -0.9811 | 0.6643 | -0.9466 |
| 11 | 34 | 1.1259 | 0.3669 | No | 1.0106 | 0.1325 | 0.8056 | -0.2516 |
| 12 | 16 | -1.0139 | 0.3483 | No | 1.6857 | 2.2459 | 3.8052 | 4.9796 |
| 13 | 23 | -0.2040 | 0.3371 | No | 0.7540 | -0.9548 | 0.7117 | -0.8847 |
| 14 | 22 | -0.3175 | 0.3369 | No | 1.7208 | 2.4066 | 1.8127 | 2.1610 |
| 15 | 26 | 0.1394 | 0.3402 | No | 0.9218 | -0.2115 | 1.5323 | 1.4374 |
| 16 | 42 | 2.4154 | 0.4546 | No | 0.5708 | -1.3311 | 0.3199 | -0.7610 |
| 17 | 46 | 3.5154 | 0.6295 | No | 1.4274 | 0.8893 | 0.4952 | 0.0283 |
| 18 | 40 | 2.0354 | 0.4195 | No | 0.9747 | 0.0285 | 0.5981 | -0.3802 |
| 19 | 31 | 0.7377 | 0.3533 | No | 0.9511 | -0.0847 | 0.7797 | -0.4200 |
| 20 | 25 | 0.0242 | 0.3387 | No | 1.0409 | 0.2409 | 0.9106 | -0.1608 |
| 21 | 27 | 0.2557 | 0.3420 | No | 0.2725 | -3.8203 | 0.2895 | -2.7121 |
| 22 | 34 | 1.1259 | 0.3669 | No | 0.3280 | -3.1417 | 0.3031 | -1.8075 |
| 23 | 39 | 1.8649 | 0.4067 | No | 0.4233 | -2.2830 | 0.3568 | -1.0275 |
| 24 | 31 | 0.7377 | 0.3533 | No | 0.9201 | -0.2008 | 0.7593 | -0.4770 |
| 25 | 41 | 2.2178 | 0.4351 | No | 1.0048 | 0.1261 | 0.6150 | -0.2781 |

**EXAM 1**

**Item Stats for all 56 items**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Item** | **b-parameter** | **Std. Error** | **WMS** | **Std. WMS** | **UMS** | **Std. UMS** |
| item1 | -0.8456 | 0.0311 | 1.0394 | 2.7867 | 1.0222 | 0.8931 |
| item2 | 0.0880 | 0.0287 | 1.1246 | 11.0826 | 1.1572 | 9.7177 |
| item3 | -1.5068 | 0.0355 | 0.8975 | -5.3206 | 0.7718 | -6.6527 |
| item4 | -0.1368 | 0.0289 | 1.1458 | 12.6070 | 1.2087 | 11.7853 |
| item5 | -0.5340 | 0.0298 | 1.0678 | 5.4070 | 1.1223 | 5.7303 |
| item6 | -0.9879 | 0.0318 | 0.9934 | -0.4328 | 0.9763 | -0.8701 |
| item7 | 0.4267 | 0.0288 | 1.0680 | 6.0316 | 1.1087 | 6.8707 |
| item8 | -1.8683 | 0.0391 | 0.8722 | -5.4130 | 0.6581 | -8.5054 |
| item9 | 0.0178 | 0.0288 | 1.0648 | 5.8503 | 1.0753 | 4.6921 |
| item10 | -1.4881 | 0.0353 | 0.8522 | -7.8917 | 0.7080 | -8.8459 |
| item11 | -1.6247 | 0.0365 | 0.8575 | -7.0111 | 0.6664 | -9.5057 |
| item12 | -0.0302 | 0.0288 | 1.0549 | 4.9575 | 1.0663 | 4.0806 |
| item13 | -1.2355 | 0.0333 | 0.8548 | -8.9312 | 0.7491 | -8.6869 |
| item14 | 0.3638 | 0.0287 | 1.0852 | 7.5814 | 1.1102 | 7.0270 |
| item15 | -0.4729 | 0.0297 | 0.9261 | -6.3006 | 0.8986 | -5.2961 |
| item16 | 0.4898 | 0.0289 | 1.0831 | 7.2595 | 1.1181 | 7.3449 |
| item17 | 0.5558 | 0.0289 | 1.0551 | 4.7999 | 1.0667 | 4.1384 |
| item18 | 0.2896 | 0.0287 | 1.0923 | 8.2527 | 1.1176 | 7.5175 |
| item19 | -0.6203 | 0.0301 | 0.8418 | -13.1965 | 0.7605 | -12.0733 |
| item20 | 0.2147 | 0.0287 | 1.0537 | 4.8804 | 1.0517 | 3.3707 |
| item21 | -0.1268 | 0.0289 | 0.9779 | -2.0108 | 0.9614 | -2.3602 |
| item22 | 0.5382 | 0.0289 | 1.0014 | 0.1240 | 1.0227 | 1.4418 |
| item23 | 0.8790 | 0.0296 | 1.0500 | 3.9885 | 1.1298 | 6.8332 |
| item24 | -0.1159 | 0.0289 | 0.8772 | -11.6349 | 0.8204 | -11.6279 |
| item25 | 0.2090 | 0.0287 | 0.9648 | -3.2888 | 0.9497 | -3.3803 |
| item26 | -1.0440 | 0.0321 | 0.9029 | -6.4997 | 0.8619 | -5.1389 |
| item27 | 2.1981 | 0.0377 | 1.0787 | 3.3760 | 1.4500 | 9.8056 |
| item28 | 0.7600 | 0.0293 | 1.1290 | 10.4133 | 1.1722 | 9.5076 |
| item29 | 0.4948 | 0.0289 | 1.0791 | 6.9179 | 1.1042 | 6.4984 |
| item30 | 0.6112 | 0.0290 | 1.0799 | 6.8166 | 1.1100 | 6.6022 |
| item31 | 0.9160 | 0.0297 | 1.1612 | 12.2568 | 1.2366 | 11.8240 |
| item32 | 1.1249 | 0.0305 | 1.1743 | 12.2070 | 1.3374 | 14.5113 |
| item33 | -0.6212 | 0.0301 | 0.9788 | -1.6789 | 0.9453 | -2.5663 |
| item34 | 0.2740 | 0.0287 | 0.9831 | -1.5617 | 0.9673 | -2.1886 |
| item35 | -0.5242 | 0.0298 | 0.8804 | -10.1958 | 0.8059 | -10.1842 |

**EXAM 1**

**Item Stats for all 56 items**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Item** | **Difficulty** | **Std. Error** | **WMS** | **Std. WMS** | **UMS** | **Std. UMS** |
| item36 | -0.2973 | 0.0292 | 0.8747 | -11.4651 | 0.8099 | -11.3366 |
| item37 | 0.0888 | 0.0287 | 0.9321 | -6.4274 | 0.9257 | -4.9469 |
| item38 | 0.6873 | 0.0292 | 1.1184 | 9.7874 | 1.1699 | 9.7066 |
| item39 | 1.0650 | 0.0302 | 1.1236 | 8.9959 | 1.1933 | 8.9712 |
| item40 | -0.2879 | 0.0292 | 1.0032 | 0.2816 | 1.0226 | 1.2627 |
| item41 | -0.3944 | 0.0294 | 0.9189 | -7.1110 | 0.9174 | -4.4810 |
| item42 | 0.1736 | 0.0287 | 1.0548 | 4.9913 | 1.0803 | 5.1600 |
| item43 | -0.4152 | 0.0295 | 0.9958 | -0.3564 | 0.9930 | -0.3580 |
| item44 | 0.8772 | 0.0296 | 1.0373 | 2.9873 | 1.0913 | 4.8699 |
| item45 | 0.0880 | 0.0287 | 0.9273 | -6.8972 | 0.8966 | -6.9518 |
| item46 | 0.0393 | 0.0287 | 0.8834 | -11.2056 | 0.8695 | -8.7611 |
| item47 | 0.4284 | 0.0288 | 0.9990 | -0.0855 | 1.0055 | 0.3672 |
| item48 | 0.3548 | 0.0287 | 0.9774 | -2.0802 | 0.9693 | -2.0476 |
| item49 | 0.2748 | 0.0287 | 1.0542 | 4.9123 | 1.0770 | 4.9875 |
| item50 | -0.3883 | 0.0294 | 0.8312 | -15.3227 | 0.7521 | -14.3933 |
| item51 | -0.4985 | 0.0297 | 0.7965 | -18.0704 | 0.7066 | -16.2966 |
| item52 | 0.2460 | 0.0287 | 0.9436 | -5.3040 | 0.9391 | -4.1140 |
| item53 | 0.2518 | 0.0287 | 0.9756 | -2.2690 | 0.9696 | -2.0346 |
| item54 | 0.8214 | 0.0295 | 1.1516 | 11.9326 | 1.2056 | 10.9069 |
| item55 | 0.6441 | 0.0291 | 1.0284 | 2.4465 | 1.0545 | 3.2856 |
| item56 | -0.4265 | 0.0295 | 0.8505 | -13.3103 | 0.7985 | -11.2305 |

**LIKING SCIENCE**

**Item Stats for all 25 items**

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| **Item** | **Difficulty** | **Std. Error** | **WMS** | **Std. WMS** | **UMS** | **Std. UMS** |
| q1 | -0.89 | 0.23 | 0.73 | -1.93 | 0.67 | -1.83 |
| q2 | -0.61 | 0.2 | 0.76 | -1.49 | 0.56 | -1.43 |
| q3 | 0.28 | 0.2 | 0.66 | -2.63 | 0.62 | -2.51 |
| q4 | 1.8 | 0.21 | 0.99 | -0.02 | 0.98 | -0.05 |
| q5 | 2.19 | 0.22 | 2.29 | 5.29 | 3.99 | 6.99 |
| q6 | 0.16 | 0.2 | 0.88 | -0.79 | 0.82 | -1.01 |
| q7 | 0.99 | 0.19 | 0.97 | -0.17 | 1.01 | 0.09 |
| q8 | 1.64 | 0.21 | 1.17 | 1.14 | 1.23 | 1.42 |
| q9 | 0.6 | 0.18 | 1.11 | 0.84 | 1.14 | 0.77 |
| q10 | -1.57 | 0.26 | 0.78 | -1.09 | 0.56 | -1.14 |
| q11 | -1.37 | 0.24 | 0.73 | -1.82 | 0.59 | -1.67 |
| q12 | -1.14 | 0.33 | 0.82 | -0.94 | 0.58 | -0.89 |
| q13 | -0.9 | 0.22 | 0.85 | -0.64 | 0.7 | -0.39 |
| q14 | 0.29 | 0.2 | 0.87 | -0.87 | 0.81 | -1.14 |
| q15 | -0.56 | 0.21 | 0.75 | -1.67 | 0.61 | -1.69 |
| q16 | 0.47 | 0.21 | 1.09 | 0.66 | 1.05 | 0.36 |
| q17 | 0.05 | 0.19 | 0.66 | -2.59 | 0.6 | -2.35 |
| q18 | -2.26 | 0.41 | 1.23 | 0.58 | 1.18 | 0.55 |
| q19 | -2.16 | 0.34 | 0.97 | 0.03 | 1.1 | 0.38 |
| q20 | 1.75 | 0.21 | 1.36 | 2.14 | 1.8 | 3.72 |
| q21 | -0.81 | 0.21 | 0.73 | -1.58 | 0.55 | -1.5 |
| q22 | -0.01 | 0.19 | 0.8 | -1.39 | 0.71 | -1.48 |
| q23 | 1.95 | 0.21 | 2.37 | 5.82 | 4.67 | 8.55 |
| q24 | -0.32 | 0.19 | 0.79 | -1.41 | 0.69 | -1.21 |
| q25 | 0.42 | 0.19 | 0.78 | -1.61 | 0.72 | -1.67 |

**EXAM 1**

**ITEM ICCs AND IICs**











**LIKING SCIENCE**

**ITEM ICCs AND IICs**











**EXAM ITEM MAP**



**LIKING SCIENCE ITEM MAP**



**EXAM 1**

**Non-Parametric Curve for Item 27.**

