9.6 or 24/25

Arnar Gudjon Skulason
Student ID: 32620

3.1.2015

R Computer Lab 2

Question 1 – Item Response Functions and Person Estimates

2

a) Looking at the item difficulties for each item (b parameter), item 5 was the easiest item ($b_{item\ 5} = -1.63$) and item 10 was the hardest item ($b_{item\ 10} = 0.53$).

b) Item 5 was the easiest item and using the standard error of the difficulty of this item, we can calculate 95% confidence interval:
$SE_{difficulty\ item\ 5} = 0.13 \rightarrow 95\%\ CI = -1.63 \pm 1.96 \times 0.13 = -1.63 \pm 0.25$
Therefore, we can be 95% confident that the item difficulty of item 5 lies between -1.88 and -1.38.

1.5 points. But note we are talking about the population value for item difficulty or the true value

c) Figure 1 provides the Item Response Functions (IRFs) for items 5 and 10 (i.e. both the easiest and the hardest item).

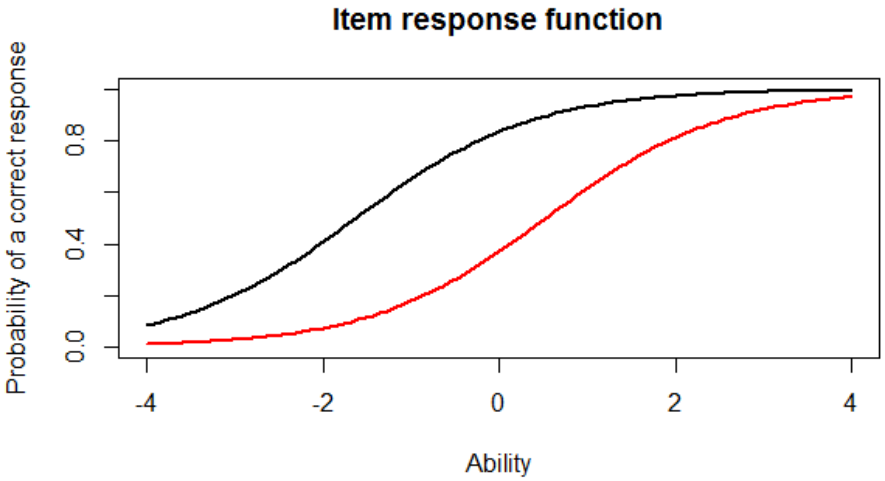

Figure 1.

1 point

d) Looking at the IRFs in Figure 1, we can estimate that someone with the ability score of 0 would have an ~85% probability of getting item 5 correct and a ~40% probability of getting item 10 correct.

2 points

e) Person #49 did the best on the test and his/her score was roughly 4.00 and person #393 did the worst on the test and his/her score was roughly -4.00.

2 points

f) Person #49 did the best on the test and using the standard error of measurement for this student we can calculate the 95% confidence interval:
$SEM_{person\ \#49} = 2.20 \rightarrow 95\%\ CI = 4.00 \pm 1.96 \times 2.20 = 4.00 \pm 4.31$
Therefore, we can be 95% confident that the score of person #49 lies between -0.31 and 8.31. This extremely broad confidence interval indicates that the measure of person's #49 score in very inaccurate and the test provides little if any information about his/her ability.

1.5 points. Good. Remember we are talking about the true population value

Question 2 – Information

a) The three items I selected to investigate were items 1, 6, and 16.

1 point

b) Figure 2 provides the Item Information Functions (IIFs) for items 1, 6, and 16.

1 point

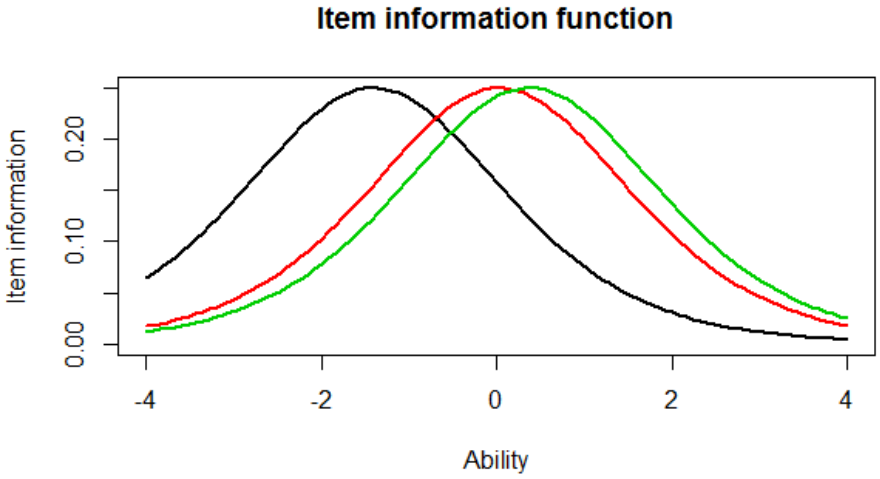

Figure 2.

c) The shape of these three IIFs is the same, indicating that the item discrimination of these three items is the same. However, they all provide the most information at different locations, indicating that the item difficulty of these three items is different.

2 points

d) Figure 2 provides the Test Information Function (TIF) of the test in question.

1 point

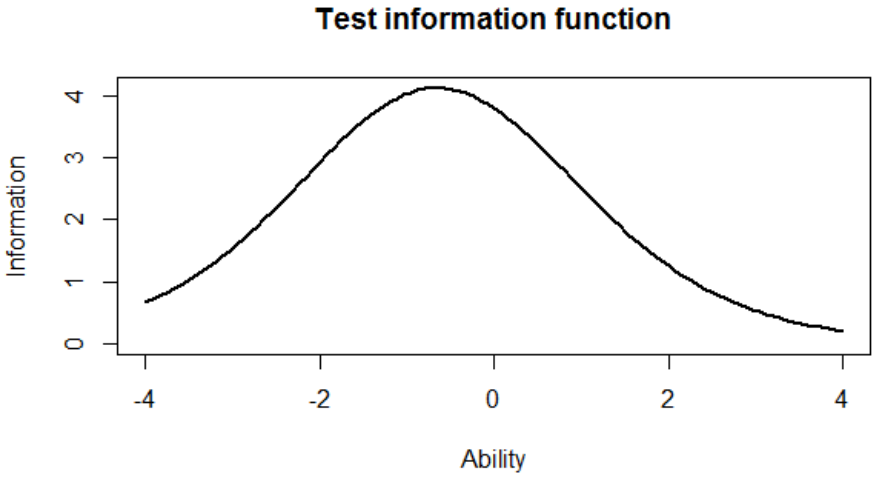

Figure 3.

e) The TIF in figure 2 indicates that the majority of the information for this test is located at around $\theta \approx -0.60$, or around the peak of the curve displayed above.

1 point

Question 3 – Comparing the 2-PL

a) Looking at the item discrimination for each item (parameter a), item 8 had the highest discrimination ($a_{item\,8} = 2.29$) and item 12 has the lowest discrimination ($a_{item\,12} = 0.33$).

2 points

b) In the Rasch model, item 5 was the easiest and item 10 the hardest. In the 2-PL, item 10 was also the hardest ($b_{item\,10} = 0.49$) but item 1 was the easiest ($b_{item\,1} = -2.00$).

1 point

c) The correlation between the ability estimates on the Rasch model and the 2-PL was very strong, $r = 0.97$. Because this correlation coefficient is not exactly 1.00, we would not draw exactly the same conclusions about person abilities using the two models. However, the estimates from both models would likely be very similar indeed.

2 points

d) Figure 4 provides the Item Information Functions (IIFs) for items 1, 6, and 16.

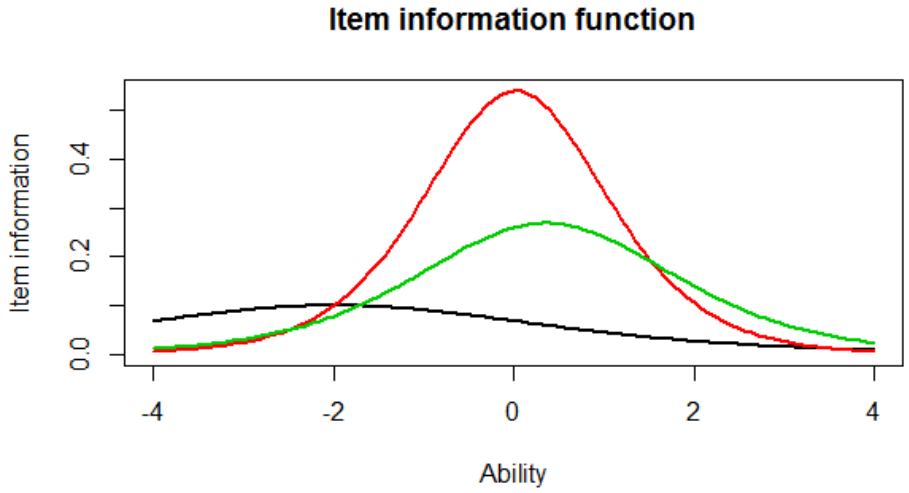

Figure 4. 1 point

e) Here, the IIFs in figure 4 differ on two parameters. First, their item difficulties are different, as indicated by the different locations of the peaks of their respective curves. Second, their item discriminations are different, indicated by the different shapes of the curves. Here, item 1 (gray curve) has the lowest item discrimination ($a_{item\,1} = 0.63$) and item 6 (red curve) has the highest item discrimination ($a_{item\,6} = 1.47$).

In essence, the 2-PL IIFs from these items differ from their Rasch IIFs on two parameters, item difficulty and item discrimination. The more distinctive difference is that 2-PL IIFs include different item discrimination parameters for each item, but these are all the same for each item in the Rasch IIFs ($a = 1.00$).

2 points

Appendix: R output

	Discrimination	Difficulty	Guessing
Item 1	1	-1.40938612	0
Item 2	1	-0.35055656	0
Item 3	1	-0.90318970	0
Item 4	1	-0.97412011	0
Item 5	1	**-1.62671110**	0
Item 6	1	0.02533657	0
Item 7	1	-0.41418545	0
Item 8	1	-0.87993298	0
Item 9	1	-0.91498121	0
Item 10	1	**0.52959427**	0
Item 11	1	-1.17125435	0
Item 12	1	-0.04749604	0
Item 13	1	0.15008663	0
Item 14	1	-0.74253017	0
Item 15	1	-0.74245332	0
Item 16	1	0.36963876	0
Item 17	1	-0.84513136	0
Item 18	1	-1.45145349	0

	Discrimination SE	Difficulty SE	Guessing SE
Item 1	NA	0.1267448	0
Item 2	NA	0.1128011	0
Item 3	NA	0.1178581	0
Item 4	NA	0.1188426	0
Item 5	**NA**	**0.1320051**	0
Item 6	NA	0.1118476	0
Item 7	NA	0.1131572	0
Item 8	NA	0.1175527	0
Item 9	NA	0.1180162	0
Item 10	NA	0.1136598	0
Item 11	NA	0.1220123	0
Item 12	NA	0.1118797	0
Item 13	NA	0.1119630	0
Item 14	NA	0.1159197	0
Item 15	NA	0.1159189	0
Item 16	NA	0.1126941	0
Item 17	NA	0.1171115	0
Item 18	NA	0.1276902	0

```
> min(est_abl$est)  # Prints the minimum score
[1] -3.999947
> max(est_abl$est)  # Prints the maximum scores
[1] 3.999921
> which.min(est_abl$est)  # Prints out the person minimum score
[1] 393
> which.max(est_abl$est)  # Prints out the person with the maximum score
[1] 49
```

```
> est_abl[49,]
        est      sem  n
49 3.999921 2.204373 18
```

```
        Discrimination  Difficulty Guessing
Item 1       0.6326689 -2.00058101        0
Item 2       1.5469622 -0.26815483        0
Item 3       1.2534918 -0.77297206        0
Item 4       0.9842598 -0.97706755        0
Item 5       1.6407242 -1.19389580        0
Item 6       1.4702029  0.01833431        0
Item 7       0.5632837 -0.65124651        0
Item 8       2.2881772 -0.56753253        0
Item 9       1.8004066 -0.64761748        0
Item 10      1.1142107  0.48542889        0
Item 11      1.0344119 -1.13363005        0
Item 12      0.3329130 -0.12951933        0
Item 13      0.3369968  0.36344671        0
Item 14      0.6608229 -1.01479867        0
Item 15      1.5980393 -0.55640285        0
Item 16      1.0362116  0.35459121        0
Item 17      1.8591845 -0.59017915        0
Item 18      1.2808752 -1.22177042        0
```

```
> cor(twopl_abl$est,est_abl$est)
[1] 0.9709497
```