

# HUDM6052 Psychometric II Homework\_04

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### Q1-a-Parameters-Estimation

*Fit the 1PL, 2PL, and 3PL models...report the estimated item parameters in separated tables*

#### My Solution:

To make the layout concise and good-looking, I intentionally omitted the codes for data cleaning and some instant display of running outcomes. I attached the estimated item parameters from all three models into one table to save space.

```
> # load the binary response dataset
> library(mirt)
> df <- read.csv("/Users/panpeter/Desktop/PhD_Learning/HUDM6052 Psychometric II/HUDM6052_Psychometric_II.
> df <- df[,-1]
>
> # -----
> #                               Run 1PL
> # -----
>
> # specify the model for 33 items loading on 1 dimension
> # and constrain all the item slope to be equal for 1PL estimation
> spec <- 'F = 1-33
+ CONSTRAIN = (1-33, a1)'
>
> # estimated the model
> # since I constrained all slopes to be equal, here the argument "2PL" is safe
> irt_1pl <- mirt(df, model = spec, itemtype = "2PL", SE=T)
Iteration: 1, Log-Lik: -20276.377, Max-Change: 0.18304Iteration: 2, Log-Lik: -20265.381, Max-Change: 0.0
Calculating information matrix...
> irt_1pl

Call:
mirt(data = df, model = spec, itemtype = "2PL", SE = T)

Full-information item factor analysis with 1 factor(s).
Converged within 1e-04 tolerance after 25 EM iterations.
mirt version: 1.40
```

```

M-step optimizer: BFGS
EM acceleration: Ramsay
Number of rectangular quadrature: 61
Latent density type: Gaussian

Information matrix estimated with method: Oakes
Second-order test: model is a possible local maximum
Condition number of information matrix = 50.40657

Log-likelihood = -20260.22
Estimated parameters: 66
AIC = 40588.44
BIC = 40756.74; SABIC = 40648.75

```

```

> # -----
> #                               Run 2PL
> # -----
> irt_2pl <- mirt(df, model = 1, itemtype = "2PL", SE=T)
Iteration: 1, Log-Lik: -20276.377, Max-Change: 0.63072Iteration: 2, Log-Lik: -20095.717, Max-Change: 0.14172

Calculating information matrix...
> irt_2pl

Call:
mirt(data = df, model = 1, itemtype = "2PL", SE = T)

Full-information item factor analysis with 1 factor(s).
Converged within 1e-04 tolerance after 32 EM iterations.
mirt version: 1.40
M-step optimizer: BFGS
EM acceleration: Ramsay
Number of rectangular quadrature: 61
Latent density type: Gaussian

Information matrix estimated with method: Oakes
Second-order test: model is a possible local maximum
Condition number of information matrix = 11.16451

Log-likelihood = -20078.62
Estimated parameters: 66
AIC = 40289.23
BIC = 40615.92; SABIC = 40406.3

```

```

> # -----
> #                               Run 3PL
> # -----
> # specify the model
> spec <- 'F = 1-33
+ PRIOR = (1-33, g, norm, -1.1, 2)'
> irt_3pl <- mirt(df, model = spec, itemtype = "3PL", SE = T)
Iteration: 1, Log-Lik: -20990.083, Max-Change: 1.61517Iteration: 2, Log-Lik: -20300.703, Max-Change: 1.41172

```

```
> irt_3pl

Call:
mirt(data = df, model = spec, itemtype = "3PL", SE = T)

Full-information item factor analysis with 1 factor(s).
Converged within 1e-04 tolerance after 136 EM iterations.
mirt version: 1.40
M-step optimizer: BFGS
EM acceleration: Ramsay
Number of rectangular quadrature: 61
Latent density type: Gaussian

Information matrix estimated with method: Oakes
Second-order test: model is a possible local maximum
Condition number of information matrix = 783.5905

Log-posterior = -20064.48
Estimated parameters: 99
AIC = 40212.78
BIC = 40702.82; SABIC = 40388.38
```

Items	1PL				2PL				3PL			
	a	b	g	u	a	b	g	u	a	b	g	u
mathc1	0.960	-0.881	0	1	1.078	-0.816	0	1	1.385	-0.250	0.238	1
mathc2	0.960	-1.706	0	1	1.135	-1.516	0	1	1.198	-1.170	0.198	1
mathc3	0.960	-0.162	0	1	1.307	-0.145	0	1	1.529	0.080	0.095	1
mathc4	0.960	-0.412	0	1	1.308	-0.349	0	1	2.095	0.170	0.235	1
mathc5	0.960	1.104	0	1	0.627	1.556	0	1	2.282	1.443	0.187	1
mathc6	0.960	-0.696	0	1	1.352	-0.569	0	1	1.428	-0.432	0.060	1
mathc7	0.960	-0.457	0	1	1.044	-0.434	0	1	1.247	-0.081	0.141	1
mathc8	0.960	-0.562	0	1	0.897	-0.589	0	1	0.951	-0.395	0.071	1
mathc9	0.960	-2.089	0	1	1.415	-1.609	0	1	1.464	-1.443	0.129	1
mathc11	0.960	-0.668	0	1	1.243	-0.571	0	1	1.956	0.092	0.293	1
mathc12	0.960	-0.470	0	1	0.856	0.514	0	1	1.130	0.802	0.114	1
mathc13	0.960	-1.212	0	1	1.535	-0.910	0	1	2.546	-0.207	0.360	1
mathc14	0.960	0.552	0	1	0.775	0.655	0	1	0.887	0.819	0.060	1
mathc15	0.960	0.498	0	1	0.726	0.624	0	1	0.858	0.838	0.075	1
mathc16	0.960	-0.216	0	1	0.829	-0.237	0	1	0.942	0.027	0.090	1
mathc17	0.960	0.715	0	1	0.837	0.795	0	1	1.254	1.050	0.125	1
mathc18	0.960	0.767	0	1	1.107	0.688	0	1	1.253	0.757	0.034	1
mathc19	0.960	0.290	0	1	0.551	0.475	0	1	1.432	1.302	0.297	1
mathc21	0.960	-0.004	0	1	0.607	0.011	0	1	3.411	1.149	0.407	1
mathc22	0.960	-0.253	0	1	0.990	-0.250	0	1	1.401	0.295	0.212	1
mathc23	0.960	-0.085	0	1	0.688	-0.099	0	1	1.428	0.863	0.316	1
mathc24	0.960	-0.052	0	1	0.986	-0.053	0	1	1.460	0.460	0.202	1
mathc25	0.960	-0.170	0	1	1.230	-0.155	0	1	1.517	0.132	0.122	1
mathc26	0.960	0.332	0	1	0.893	0.350	0	1	1.177	0.672	0.125	1
mathc27	0.960	-0.282	0	1	1.479	-0.232	0	1	1.719	-0.018	0.094	1
mathc28	0.960	-0.026	0	1	1.949	-0.044	0	1	2.260	0.100	0.058	1
mathc29	0.960	0.119	0	1	1.229	0.092	0	1	1.928	0.476	0.173	1
mathc31	0.960	1.250	0	1	0.723	1.564	0	1	1.699	1.576	0.150	1
mathc32	0.960	-0.476	0	1	0.837	-0.522	0	1	1.600	0.481	0.350	1
mathc33	0.960	0.176	0	1	1.284	0.134	0	1	2.790	0.582	0.217	1
mathc34	0.960	0.165	0	1	0.678	0.229	0	1	0.863	0.645	0.131	1
mathc35	0.960	0.667	0	1	0.360	1.577	0	1	1.480	1.899	0.288	1
mathc36	0.960	1.449	0	1	1.060	1.352	0	1	1.601	1.359	0.070	1

Due to the limitation of `mirt` package, I can't constrain all the  $\alpha$  to be 1. Rather, I can only set them to be equal across all the items. Therefore, in the estimation for the 1PL, the estimated universal  $\alpha$  is .96 here.