

# MBR Review

4/30/2020

(1) LRT: Try “add” function without anchor items (but instead, you delete “free mean” and “free variance” options) on one condition, such as  $N=1500$ ,  $\text{correlation}=0.25$ ,  $\text{DIF proportion}=0.2$ , and see how LRT performs.

Try to figure out if “add\_sequential” works, and if not, you can write to the author to ask. We do not necessarily have to include it in the simulation study, but if not, we need to properly justify.

Maybe you can copy your R code for LRT in this email. I am asking because when you use “add\_sequential”, you need to specify “seq\_stat” and I prefer to use  $\text{seq\_stat}=0.05$ , which corresponds to LRT or Wald test? We should not use other information criteria as they are not relevant for LRT.

(2) Re-run the regularization methods for the uniform DIF for all conditions. Save all 50 replication results and compute the standard deviation of Type I error, power, and mean absolute bias (see tables 3-5).

Table 1: Study III Type I error of detecting uniform DIF

Corr	N	DIF%	Group	LRT	LASSO EM	LASSO EMM	Adaptive LASS
0.85	1500	20%	Omnibus DIF	0.028	0.043 (0.007)	0.021 (0.005)	0 (0)
			Low DIF group	0.013	0.012 (0.004)	0.013 (0.004)	0 (0)
			High DIF group	0.013	0.028 (0.005)	0.011 (0.003)	0 (0)
		60%	Omnibus DIF	0.893	0.200 (0.023)	0.035 (0.011)	0.008 (0.008)
			Low DIF group	0.308	0.098 (0.016)	0.025 (0.009)	0.005 (0.005)
			High DIF group	0.88	0.153 (0.02)	0.013 (0.005)	0.005 (0.005)
	3000	20%	Omnibus DIF	0.033 (0.007)	0.031 (0.007)	0.026 (0.006)	0.006 (0.002)
			Low DIF group	0.024 (0.006)	0.018 (0.005)	0.021 (0.005)	0.004 (0.002)
			High DIF group	0.024 (0.006)	0.021 (0.005)	0.006 (0.003)	0.003 (0.002)
		60%	Omnibus DIF	0.91 (0.036)	0.345 (0.027)	0.060 (0.015)	0.035 (0.035)
			Low DIF group	0.498 (0.035)	0.218 (0.02)	0.058 (0.015)	0.035 (0.035)
			High DIF group	0.498 (0.035)	0.268 (0.027)	0.008 (0.004)	0.008 (0.008)
0.25	1500	20%	Omnibus DIF	0.028 (0.005)	0.029 (0.007)	0.016 (0.005)	0.013 (0.004)
			Low DIF group (0.004)	0.013	0.011 (0.003)	0.005 (0.002)	0.005 (0.002)
			High DIF group	0.013 (0.004)	0.019 (0.007)	0.011 (0.004)	0.008 (0.003)
		60%	Omnibus DIF	0.86 (0.03)	0.084 (0.014)	0.038 (0.013)	0.020 (0.008)
			Low DIF group	0.31 (0.028)	0.076 (0.013)	0.035 (0.013)	0.020 (0.008)
			High DIF group	0.31 (0.028)	0.033 (0.010)	0.005 (0.004)	0 (0)
	3000	20%	Omnibus DIF	0.029 (0.007)	0.019 (0.006)	0.005 (0.002)	0.003 (0.002)
			Low DIF group	0.02 (0.005)	0.009 (0.004)	0.005 (0.002)	0.003 (0.002)
			High DIF group	0.02 (0.006)	0.014 (0.004)	0.003 (0.002)	0 (0)
		60%	Omnibus DIF	0.91 (0.0)	0.128 (0.015)	0.103 (0.024)	0.071 (0.011)
			Low DIF group	0.468	0.125 (0.015)	0.095 (0.022)	0.071 (0.011)
			High DIF group	0.468	0.024 (0.008)	0.010 (0.005)	0.006 (0.003)

Table 2: SE of Study III Type I error

Corr	N	DIF%	Group	LRT	LASSO EM	LASSO EMM	Adaptive LASSO
0.85	1500	20%	Omnibus DIF	0.006	0.007	0.005	0.000
			Low DIF group	0.004	0.004	0.004	0.000
			High DIF group	0.006	0.005	0.003	0.000
		60%	Omnibus DIF	0.022	0.023	0.011	0.008
			Low DIF group	0.043	0.016	0.009	0.005
			High DIF group	0.022	0.020	0.005	0.005
	3000	20%	Omnibus DIF	0.006	0.007	0.006	0.002
			Low DIF group	0.004	0.005	0.005	0.002
			High DIF group	0.006	0.005	0.003	0.002
		60%	Omnibus DIF	0.027	0.027	0.015	0.035
			Low DIF group	0.044	0.020	0.015	0.035
			High DIF group	0.027	0.027	0.004	0.008
0.25	1500	20%	Omnibus DIF	0.005	0.007	0.005	0.004
			Low DIF group	0.004	0.003	0.002	0.002
			High DIF group	0.004	0.007	0.004	0.003
		60%	Omnibus DIF	0.024	0.014	0.013	0.008
			Low DIF group	0.036	0.013	0.013	0.008
			High DIF group	0.024	0.010	0.004	0
	3000	20%	Omnibus DIF	0.007	0.006	0.002	0.002
			Low DIF group	0.004	0.004	0.002	0.002
			High DIF group	0.007	0.004	0.002	0.000
		60%	Omnibus DIF	0.027	0.015	0.024	0.011
			Low DIF group	0.048	0.015	0.022	0.011
			High DIF group	0.027	0.008	0.005	0.003

Table 3: Study III Power of detecting uniform DIF

Corr	N	DIF%	Group	LRT	LASSO EM	LASSO EMM	Adaptive LASSO
0.85	1500	20%	Omnibus DIF	0.985	0.965	0.96	0.985
			Low DIF group	0.615	0.455	0.55	0.470
			High DIF group	0.988	0.965	0.96	0.985
		60%	Omnibus DIF	0.147	0.678	0.885	0.885
			Low DIF group	0.027	0.232	0.208	0.193
			High DIF group	0.163	0.677	0.885	0.885
	3000	20%	Omnibus DIF	1	1.000	1.000	1.000
			Low DIF group	0.915	0.786	0.84	0.845
			High DIF group	1	1.000	1.000	1.000
		60%	Omnibus DIF	0.115	0.943	0.998	1
			Low DIF group	0.017	0.467	0.632	0.44
			High DIF group	0.120	0.942	0.998	1
0.25	1500	20%	Omnibus DIF	0.97	0.955	0.965	0.985
			Low DIF group	0.62	0.430	0.490	0.510
			High DIF group	0.975	0.955	0.965	0.985
		60%	Omnibus DIF	0.167	0.728	0.885	0.859
			Low DIF group	0.035	0.228	0.197	0.238
			High DIF group	0.175	0.728	0.885	0.859
	3000	20%	Omnibus DIF	1	1	1	1
			Low DIF group	0.895	0.806	0.907	0.878
			High DIF group	1	1	1	1
		60%	Omnibus DIF	0.123	0.944	0.998	1
			Low DIF group	0.023	0.356	0.513	0.317
			High DIF group	0.132	0.944	0.998	1

Table 4: SE of Study III Power

Corr	N	DIF%	Group	LRT	LASSO EM	LASSO EMM	Adaptive LASSO
0.85	1500	20%	Omnibus DIF	0.008	0.013	0.017	0.009
			Low DIF group	0.045	0.036	0.043	0.050
			High DIF group	0.008	0.012	0.017	0.009
		60%	Omnibus DIF	0.022	0.027	0.019	0.024
			Low DIF group	0.007	0.019	0.024	0.021
			High DIF group	0.007	0.027	0.019	0.024
	3000	20%	Omnibus DIF	0	0	0	0
			Low DIF group	0.022	0.039	0.029	0.032
			High DIF group	0.022	0	0	0
		60%	Omnibus DIF	0.016	0.010	0.002	0
			Low DIF group	0.006	0.023	0.032	0.038
			High DIF group	0.016	0.010	0.002	0
0.25	1500	20%	Omnibus DIF	0.012	0.013	0.013	0.009
			Low DIF group	0.041	0.037	0.040	0.041
			High DIF group	0.012	0.013	0.013	0.009
		60%	Omnibus DIF	0.020	0.035	0.022	0.024
			Low DIF group	0.009	0.018	0.023	0.017
			High DIF group	0.020	0.035	0.022	0.024
	3000	20%	Omnibus DIF	0	0	0	0
			Low DIF group	0.022	0.036	0.022	0.028
			High DIF group	0	0	0	0
		60%	Omnibus DIF	0.018	0.009	0.002	0
			Low DIF group	0.009	0.015	0.033	0.024
			High DIF group	0.018	0.009	0.002	0

Table 5: Simulation III DIF Parameter Absolute bias

Corr	N	DIF%	Group	LRT	LASSO EM	LASSO EMM	Adaptive LASSO
0.85	1500	20%	Omnibus DIF	0.136	0.196	0.177	0.173
			Low DIF group	0.143	0.141	0.131	0.114
			High DIF group	0.141	0.216	0.197	0.198
		60%	Omnibus DIF	0.162	0.238	0.211	0.232
			Low DIF group	0.123	0.119	0.118	0.104
			High DIF group	0.164	0.278	0.226	0.253
	3000	20%	Omnibus DIF	0.112	0.109	0.104	0.111
			Low DIF group	0.113	0.097	0.090	0.099
			High DIF group	0.112	0.119	0.117	0.119
		60%	Omnibus DIF	0.113	0.167	0.140	0.182
			Low DIF group	0.195	0.133	0.097	0.118
			High DIF group	0.119	0.182	0.165	0.206
0.25	1500	20%	Omnibus DIF	0.164	0.168	0.198	0.172
			Low DIF group	0.186	0.118	0.115	0.116
			High DIF group	0.148	0.191	0.241	0.200
		60%	Omnibus DIF	0.165	0.198	0.201	0.195
			Low DIF group	0.121	0.111	0.109	0.101
			High DIF group	0.166	0.231	0.221	0.219
	3000	20%	Omnibus DIF	0.112	0.126	0.114	0.116
			Low DIF group	0.107	0.097	0.096	0.098
			High DIF group	0.117	0.149	0.131	0.133
		60%	Omnibus DIF	0.122	0.174	0.145	0.155
			Low DIF group	0.201	0.123	0.112	0.106
			High DIF group	0.124	0.195	0.165	0.178

Table 6: Non-uniform DIF magnitude measured by wABC

Item	4	5	6	7	8	9
Focal 1	0.342	0.721	0.612	0.764	0.717	0.955
Focal 2	0.712	1.626	0.982	1.712	1.621	1.951
Item	12	13	14	15	16	17
Focal 1	0.803	0.784	0.533	0.768	0.882	0.958
Focal 2	1.711	1.749	1.237	1.724	1.913	1.775

Table 7: Study IV Type I error of detecting non-uniform DIF

Corr	N	DIF%	Group	LRT	LASSO EM	LASSO EMM	Adaptive LASSO
0.85	1500	20%	Omnibus DIF	0.029	0.045 (0.009)	0.036 (0.006)	0.042 (0.008)
			Low DIF group	0.013	0.020 (0.006)	0.020 (0.004)	0.023 (0.005)
			High DIF group	0.018	0.030 (0.007)	0.020 (0.005)	0.026 (0.007)
		60%	Omnibus DIF		0.037 (0.009)	0.035 (0.014)	0.02 (0.006)
			Low DIF group		0.023 (0.007)	0.017 (0.007)	0.015 (0.005)
			High DIF group		0.032 (0.008)	0.022 (0.013)	0.007 (0.004)
	3000	20%	Omnibus DIF	0.02	0.032 (0.007)	0.035 (0.007)	0.035 (0.007)
			Low DIF group	0.014	0.018 (0.005)	0.017 (0.005)	0.015 (0.004)
			High DIF group	0.015	0.032 (0.004)	0.026 (0.005)	0.028 (0.005)
		60%	Omnibus DIF		0.042 (0.009)	0.015 (0.006)	0.05 (0.013)
			Low DIF group		0.020 (0.006)	0.005 (0.003)	0.017 (0.006)
			High DIF group		0.037 (0.009)	0.012 (0.006)	0.045 (0.011)
0.25	1500	20%	Omnibus DIF	0.018 (0.004)	0.036 (0.007)	0.038 (0.006)	0.032 (0.006)
			Low DIF group	0.006 (0.003)	0.018 (0.005)	0.026 (0.006)	0.017 (0.005)
			High DIF group	0.015 (0.004)	0.025 (0.005)	0.021 (0.004)	0.017 (0.004)
		60%	Omnibus DIF		0.077 (0.016)	0.030 (0.009)	0.036 (0.012)
			Low DIF group		0.030 (0.008)	0.020 (0.005)	0.024 (0.010)
			High DIF group		0.070 (0.014)	0.013 (0.008)	0.017 (0.009)
	3000	20%	Omnibus DIF	0.026 (0.005)	0.026 (0.006)	0.046 (0.010)	0.048 (0.007)
			Low DIF group	0.016 (0.004)	0.015 (0.004)	0.026 (0.008)	0.028 (0.006)
			High DIF group	0.022 (0.005)	0.012 (0.004)	0.032 (0.006)	0.03 (0.005)
		60%	Omnibus DIF		0.105 (0.015)	0.026 (0.008)	0.08 (0.015)
			Low DIF group		0.06 (0.012)	0.018 (0.006)	0.035 (0.011)
			High DIF group		0.08 (0.015)	0.021 (0.006)	0.06 (0.012)



Table 8: Study IV Power of detecting non-uniform DIF

Corr	N	DIF%	Group	LRT	LASSO EM	LASSO EMM	Adaptive LASSO
0.85	1500	20%	Omnibus DIF	0.665	0.645 (0.035)	0.730 (0.029)	0.69 (0.037)
			Low DIF group	0.325	0.120 (0.024)	0.175 (0.026)	0.135 (0.028)
			High DIF group	0.66	0.645 (0.035)	0.730 (0.029)	0.69 (0.037)
		60%	Omnibus DIF		0.325 (0.029)	0.396 (0.039)	0.371 (0.039)
			Low DIF group		0.060 (0.012)	0.065 (0.013)	0.007 (0.003)
			High DIF group		0.315 (0.028)	0.395 (0.039)	0.368 (0.039)
	3000	20%	Omnibus DIF	0.905	0.890 (0.019)	0.915 (0.017)	0.91 (0.020)
			Low DIF group	0.535	0.235 (0.032)	0.335 (0.039)	0.24 (0.036)
			High DIF group	0.905	0.890 (0.019)	0.915 (0.017)	0.91 (0.020)
		60%	Omnibus DIF		0.688 (0.027)	0.845 (0.019)	0.83 (0.025)
			Low DIF group		0.158 (0.015)	0.176 (0.016)	0.133 (0.016)
			High DIF group		0.685 (0.027)	0.845 (0.019)	0.825 (0.025)
0.25	1500	20%	Omnibus DIF	0.645 (0.041)	0.695 (0.036)	0.74 (0.031)	0.69 (0.039)
			Low DIF group	0.285 (0.036)	0.130 (0.027)	0.235 (0.030)	0.13 (0.025)
			High DIF group	0.645 (0.041)	0.695 (0.036)	0.74 (0.031)	0.69 (0.039)
		60%	Omnibus DIF		0.365 (0.025)	0.382 (0.029)	0.382 (0.030)
			Low DIF group		0.071 (0.011)	0.081 (0.013)	0.083 (0.013)
			High DIF group		0.356 (0.025)	0.378 (0.028)	0.369 (0.026)
	3000	20%	Omnibus DIF	0.89 (0.017)	0.875 (0.018)	0.895 (0.019)	0.925 (0.016)
			Low DIF group	0.52 (0.037)	0.265 (0.031)	0.355 (0.042)	0.26 (0.038)
			High DIF group	0.88 (0.018)	0.875 (0.018)	0.895 (0.019)	0.92 (0.016)
		60%	Omnibus DIF		0.701 (0.025)	0.785 (0.024)	0.771 (0.027)
			Low DIF group		0.161 (0.017)	0.131 (0.015)	0.165 (0.021)
			High DIF group		0.693 (0.026)	0.785 (0.024)	0.77 (0.027)