Uniform DIF

3 group uniform DIF

|  |  |  |
| --- | --- | --- |
| File | Description | Details |
| Unif\_resp.csv | Response matrix (categories “1” and “2”) | 600 individuals \* 20 items |
| Group.csv | Group indicators | Three groups. 200 individuals per group. |
| Indic.csv | Factor loading indicators | Simple structure. 10 items each domain |

True parameters (20% Uniform DIF)

Two discrimination parameters were generated from Uniform (1.5, 2.5) and the boundary parameters were generated from N(0,1).

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| A11 | A21 | D11 | Beta1 | Beta2 |
| 2.177533 | 0 | 0.031216 | 0 | 0 |
| 0 | 2.462224 | -1.28415 | 0 | 0 |
| 1.927346 | 0 | 0.583933 | 0 | 0 |
| 2.410381 | 0 | -2.06891 | 1 | 1.5 |
| 2.455728 | 0 | 0.120023 | 1 | 1.5 |
| 2.340659 | 0 | -3.25984 | 0 | 0 |
| 1.843661 | 0 | -0.41698 | 0 | 0 |
| 1.856577 | 0 | -0.51721 | 0 | 0 |
| 1.92839 | 0 | 0.892665 | 0 | 0 |
| 1.947499 | 0 | 1.332311 | 0 | 0 |
| 1.902594 | 0 | 0.850175 | 0 | 0 |
| 0 | 2.438204 | 0.820125 | 1 | 1.5 |
| 0 | 1.821228 | -0.37809 | 1 | 1.5 |
| 0 | 2.226039 | -0.9986 | 0 | 0 |
| 0 | 1.930993 | -0.27731 | 0 | 0 |
| 0 | 1.883545 | 0.191088 | 0 | 0 |
| 0 | 1.843101 | 1.734021 | 0 | 0 |
| 0 | 2.123956 | 0.058013 | 0 | 0 |
| 0 | 2.421439 | -1.8693 | 0 | 0 |
| 0 | 2.158204 | -0.63405 | 0 | 0 |

DIF detection results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | EM | EMM | Adapt | LRT | GVEMM |
| Group1 Type I error | 0 | 0 | 0 | 0 | 0 |
| Group1 Power | 0.75 | 0.5 | 0.75 | 0.75 | 0.5 |
| Group2 Type I error | 0 | 0 | 0 | 0 | 0 |
| Group2 Power | 1 | 1 | 1 | 0.75 | 1 |

Running time

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  | EM | EMM | Adapt | LRT | GVEMM | GVEMM |
| Running time in minutes | 5 | 3 | 5 | 5 | 5 | 5 |

2 group uniform DIF

|  |  |  |
| --- | --- | --- |
| resp2grp.csv | Response matrix (categories “1” and “2”) | 400 individuals \* 20 items |
| Group2grp.csv | Group indicators | Two groups. 200 individuals per group. |
| Indic.csv | Factor loading indicators | Simple structure. 10 items each domain |
| Unif2grp\_results | Item parameter estimates of four methods |  |

True parameters (20% Uniform DIF)

Two discrimination parameters were generated from Uniform(1.5, 2.5) and the boundary parameters were generated from N(0,1). No impact simulated.

|  |  |  |  |
| --- | --- | --- | --- |
| A11 | A21 | D11 | Beta1 |
| 2.177533 | 0 | 0.031216 | 0 |
| 0 | 2.462224 | -1.28415 | 0 |
| 1.927346 | 0 | 0.583933 | 0 |
| 2.410381 | 0 | -2.06891 | 1 |
| 2.455728 | 0 | 0.120023 | 1 |
| 2.340659 | 0 | -3.25984 | 0 |
| 1.843661 | 0 | -0.41698 | 0 |
| 1.856577 | 0 | -0.51721 | 0 |
| 1.92839 | 0 | 0.892665 | 0 |
| 1.947499 | 0 | 1.332311 | 0 |
| 1.902594 | 0 | 0.850175 | 0 |
| 0 | 2.438204 | 0.820125 | 1 |
| 0 | 1.821228 | -0.37809 | 1 |
| 0 | 2.226039 | -0.9986 | 0 |
| 0 | 1.930993 | -0.27731 | 0 |
| 0 | 1.883545 | 0.191088 | 0 |
| 0 | 1.843101 | 1.734021 | 0 |
| 0 | 2.123956 | 0.058013 | 0 |
| 0 | 2.421439 | -1.8693 | 0 |
| 0 | 2.158204 | -0.63405 | 0 |

DIF detection results

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | EM | EMM | Adapt | LRT | GVEMM |
| Group1 Type I error | 0.0625 | 0.0625 | 0.0625 | 0 | 0 |
| Group1 Power | 1 | 1 | 1 | 0.5 | 0.75 |

Running time

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | EM | EMM | Adapt | LRT | GVEMM |
| Running time in minutes | 2 | 1 | 2 | 3 | 2 |

4 group uniform DIF

|  |  |  |
| --- | --- | --- |
| File | Description | Details |
| resp4grp.csv | Response matrix (categories “0” and “1”) | 800 individuals \* 20 items |
| Group4grp.csv | Group indicators | Four groups. 200 individuals per group. |
| Indic.csv | Factor loading indicators | Simple structure. 10 items each domain |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |

True parameters ( 20% Uniform DIF)

Two discrimination parameters were generated from Uniform(1.5, 2.5) and the boundary parameters were generated from N(0,1).

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| A11 | A21 | D11 | Beta1 | Beta2 | Beta3 |
| 2.177533 | 0 | 0.031216 | 0 | 0 | 0 |
| 0 | 2.462224 | -1.28415 | 0 | 0 | 0 |
| 1.927346 | 0 | 0.583933 | 0 | 0 | 0 |
| 2.410381 | 0 | -2.06891 | 0.5 | 1 | 0.75 |
| 2.455728 | 0 | 0.120023 | 0.5 | 1 | 0.75 |
| 2.340659 | 0 | -3.25984 | 0 | 0 | 0 |
| 1.843661 | 0 | -0.41698 | 0 | 0 | 0 |
| 1.856577 | 0 | -0.51721 | 0 | 0 | 0 |
| 1.92839 | 0 | 0.892665 | 0 | 0 | 0 |
| 1.947499 | 0 | 1.332311 | 0 | 0 | 0 |
| 1.902594 | 0 | 0.850175 | 0 | 0 | 0 |
| 0 | 2.438204 | 0.820125 | 0.5 | 1 | 0.75 |
| 0 | 1.821228 | -0.37809 | 0.5 | 1 | 0.75 |
| 0 | 2.226039 | -0.9986 | 0 | 0 | 0 |
| 0 | 1.930993 | -0.27731 | 0 | 0 | 0 |
| 0 | 1.883545 | 0.191088 | 0 | 0 | 0 |
| 0 | 1.843101 | 1.734021 | 0 | 0 | 0 |
| 0 | 2.123956 | 0.058013 | 0 | 0 | 0 |
| 0 | 2.421439 | -1.8693 | 0 | 0 | 0 |
| 0 | 2.158204 | -0.63405 | 0 | 0 | 0 |

DIF detection results by each focal group

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | EM | EMM | Adapt | LRT | GVEMM |
| Group1 Type I error | 0 | 0 | 0.0625 | 0 | 0 |
| Group1 Power | 0.25 | 0.5 | 0.5 | 0.75 | 0.5 |
| Group2 Type I error | 0 | 0 | 0 | 0 | 0 |
| Group2 Power | 0.75 | 0.75 | 0.75 | 0.75 | 0.5 |
| Group3 Type I error | 0 | 0 | 0 | 0 | 0 |
| Group3 Power | 0.5 | 0.75 | 0.75 | 0.75 | 0.5 |

Running time

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | EM | EMM | Adapt | LRT | GVEMM |
| Running time in minutes | 15 | 7 | 13 | 20 | 20 |

Non-uniform DIF

3 group non-uniform DIF

|  |  |  |
| --- | --- | --- |
| File | Description | Details |
| NonUnif\_resp.csv | Response matrix (categories “1” and “2”) | 1500 individuals \* 20 items |
| Group3grp500.csv | Group indicators | Three groups. 500 individuals per group. |
| Indic.csv | Factor loading indicators | Simple structure. 10 items each domain |

True parameters ( 20% Uniform DIF)

Two discrimination parameters were generated from Uniform(1.5, 2.5) and the boundary parameters were generated from N(0,1).

The subscripts of Gamma are group (g), dimention (r).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A11 | A21 | D11 | Gam11 | Gam12 | Gam21 | Gam22 | Beta1 | Beta2 |
| 2.177533 | 0 | 0.031216 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 2.462224 | -1.28415 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.927346 | 0 | 0.583933 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2.410381 | 0 | -2.06891 | -0.8 | -1.1 | 0 | 0 | 0.75 | 1 |
| 2.455728 | 0 | 0.120023 | -0.8 | -1.1 | 0 | 0 | 0.75 | 1 |
| 2.340659 | 0 | -3.25984 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.843661 | 0 | -0.41698 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.856577 | 0 | -0.51721 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.92839 | 0 | 0.892665 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.947499 | 0 | 1.332311 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.902594 | 0 | 0.850175 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 2.438204 | 0.820125 | 0 | 0 | -0.8 | -1.1 | 0.75 | 1 |
| 0 | 1.821228 | -0.37809 | 0 | 0 | -0.8 | -1.1 | 0.75 | 1 |
| 0 | 2.226039 | -0.9986 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1.930993 | -0.27731 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1.883545 | 0.191088 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1.843101 | 1.734021 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 2.123956 | 0.058013 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 2.421439 | -1.8693 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 2.158204 | -0.63405 | 0 | 0 | 0 | 0 | 0 | 0 |

DIF detection results

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | EM | EMM | Adapt | LRT | GVEMM |
| Slope | Group1 Type I error | 0 | 0 | 0.0625 | 0 | 0 |
| Group1 Power | 0.25 | 0.5 | 1 | 0.25 | 0 |
| Intercept | Group1 Type I error | 0 | 0 | 0.0625 | 0 | 0 |
| Group1 Power | 0.75 | 0.75 | 1 | 1 | 1 |
| Slope | Group2 Type I error | 0 | 0 | 0.0625 | 0 | 0 |
| Group2 Power | 0.5 | 0.5 | 1 | 0.5 | 0 |
| Intercept | Group2 Type I error | 0 | 0 | 0.0625 | 0 | 0 |
| Group2 Power | 1 | 0.75 | 1 | 1 | 1 |

Running time

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | EM | EMM | Adapt | LRT | GVEMM |
| Running time in minutes | 15 | 8 | 15 | 20 | 13 |

2 group non-uniform DIF

|  |  |  |
| --- | --- | --- |
| NonUnif\_resp2grp.csv | Response matrix (categories “1” and “2”) | 1000 individuals \* 20 items |
| Group2grp500.csv | Group indicators | Two groups. 500 individuals per group. |
| Indic.csv | Factor loading indicators | Simple structure. 10 items each domain |

True parameters ( 20% Uniform DIF)

Two discrimination parameters were generated from Uniform(1.5, 2.5) and the boundary parameters were generated from N(0,1). No impact simulated.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| A11 | A21 | D11 | Gam11 | Gam21 | Beta1 |
| 2.177533 | 0 | 0.031216 | 0 | 0 | 0 |
| 0 | 2.462224 | -1.28415 | 0 | 0 | 0 |
| 1.927346 | 0 | 0.583933 | 0 | 0 | 0 |
| 2.410381 | 0 | -2.06891 | -1.1 | 0 | 1 |
| 2.455728 | 0 | 0.120023 | -1.1 | 0 | 1 |
| 2.340659 | 0 | -3.25984 | 0 | 0 | 0 |
| 1.843661 | 0 | -0.41698 | 0 | 0 | 0 |
| 1.856577 | 0 | -0.51721 | 0 | 0 | 0 |
| 1.92839 | 0 | 0.892665 | 0 | 0 | 0 |
| 1.947499 | 0 | 1.332311 | 0 | 0 | 0 |
| 1.902594 | 0 | 0.850175 | 0 | 0 | 0 |
| 0 | 2.438204 | 0.820125 | 0 | -1.1 | 1 |
| 0 | 1.821228 | -0.37809 | 0 | -1.1 | 1 |
| 0 | 2.226039 | -0.9986 | 0 | 0 | 0 |
| 0 | 1.930993 | -0.27731 | 0 | 0 | 0 |
| 0 | 1.883545 | 0.191088 | 0 | 0 | 0 |
| 0 | 1.843101 | 1.734021 | 0 | 0 | 0 |
| 0 | 2.123956 | 0.058013 | 0 | 0 | 0 |
| 0 | 2.421439 | -1.8693 | 0 | 0 | 0 |
| 0 | 2.158204 | -0.63405 | 0 | 0 | 0 |

DIF detection results

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | EM | EMM | Adapt | LRT | GVEMM |
| Slope | Group1 Type I error | 0 | 0 | 0 | 0 | 0 |
| Group1 Power | 0.5 | 0.75 | 0.5 | 0 | 0.25 |
| Intercept | Group1 Type I error | 0 | 0 | 0 | 0.0625 | 0.0625 |
| Group1 Power | 0.1 | 1 | 1 | 1 | 1 |

Running time

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | EM | EMM | Adapt | LRT | GVEMM |
| Running time in minutes | 10 | 5 | 10 | 10 | 10 |

4 group non-uniform DIF

|  |  |  |
| --- | --- | --- |
| File | Description | Details |
| NonUnif\_resp4grp.csv | Response matrix (categories “0” and “1”) | 2000 individuals \* 20 items |
| Group4grp500.csv | Group indicators | Four groups. 500 individuals per group. |
| Indic.csv | Factor loading indicators | Simple structure. 10 items each domain |
| NonUnif4grp\_results | Item parameter estimates of four methods | The computing time is very long in this condition. The estimation results are saved just in case. |

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  |  |  |  |  |  |

True parameters ( 20% Uniform DIF)

Two discrimination parameters were generated from Uniform(1.5, 2.5) and the boundary parameters were generated from N(0,1).

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| A11 | A21 | D11 | Gam11 | Gam12 | Gam13 | Gam21 | Gam22 | Gam23 |
| 2.177533 | 0 | 0.031216 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 2.462224 | -1.28415 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.927346 | 0 | 0.583933 | 0 | 0 | 0 | 0 | 0 | 0 |
| 2.410381 | 0 | -2.06891 | -0.8 | -1.1 | -1.2 | 0 | 0 | 0 |
| 2.455728 | 0 | 0.120023 | -0.8 | -1.1 | -1.2 | 0 | 0 | 0 |
| 2.340659 | 0 | -3.25984 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.843661 | 0 | -0.41698 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.856577 | 0 | -0.51721 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.92839 | 0 | 0.892665 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.947499 | 0 | 1.332311 | 0 | 0 | 0 | 0 | 0 | 0 |
| 1.902594 | 0 | 0.850175 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 2.438204 | 0.820125 | 0 | 0 | 0 | -0.8 | -1.1 | -1.2 |
| 0 | 1.821228 | -0.37809 | 0 | 0 | 0 | -0.8 | -1.1 | -1.2 |
| 0 | 2.226039 | -0.9986 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1.930993 | -0.27731 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1.883545 | 0.191088 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 1.843101 | 1.734021 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 2.123956 | 0.058013 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 2.421439 | -1.8693 | 0 | 0 | 0 | 0 | 0 | 0 |
| 0 | 2.158204 | -0.63405 | 0 | 0 | 0 | 0 | 0 | 0 |
| Beta1 | Beta2 | Beta3 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |
| 0.75 | 1 | 1.25 |
| 0.75 | 1 | 1.25 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |
| 0.75 | 1 | 1.25 |
| 0.75 | 1 | 1.25 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |
| 0 | 0 | 0 |

DIF detection results by each focal group

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
|  |  | EM | EMM | Adapt | LRT | GVEMM |
| Slope | Group1 Type I error | 0 | 0 | 0.0625 | 0 | 0 |
| Group1 Power | 0.5 | 0.5 | 0.5 | 1 | 0 |
| Intercept | Group1 Type I error | 0 | 0 | 0.0625 | 0 | 0 |
| Group1 Power | 1 | 1 | 1 | 1 | 0.75 |
| Slope | Group2 Type I error | 0 | 0 | 0 | 0 | 0 |
| Group2 Power | 0.5 | 0.75 | 0.5 | 1 | 0 |
| Intercept | Group2 Type I error | 0.0625 | 0 | 0 | 0 | 0 |
| Group2 Power | 1 | 1 | 1 | 1 | 0.75 |
| Slope | Group3 Type I error | 0 | 0 | 0 | 0 | 0 |
| Group3 Power | 0.5 | 0.75 | 0.5 | 1 | 0 |
| Intercept | Group3 Type I error | 0 | 0 | 0 | 0 | 0 |
| Group3 Power | 1 | 1 | 1 | 1 | 1 |

Running time

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | EM | EMM | Adapt | LRT | GVEMM |
| Running time in minutes | >30 | 10 | >30 | 20 | 20 |

Note on tuning parameter selection

Tuning parameters are selected from [y-10, y+10] with a step length 4, and , where is the sample size of covariate group g.

If the selected tuning parameter is equal to y-10, we further do estimation on [max(0,y-22), y-14].

If the selected tuning parameter is equal to y+10, we further do estimation on [y+14, y+22].

“Iteration times k=:1”: that stands for tuning parameters orders

 list of variables in the download .rds file

|  |  |  |
| --- | --- | --- |
| Variable Name | Description | Details |
| lbd | Selected tuning parameter | A scalar |
| lbd.vec | All tuning parameters | A vector |
| Gamma | DIF parameter on slope. | A number of focal groups \* number of dimensions \* number of items array. |
| Beta | DIF parameter on intercept. | A number of focal groups \* number of items matrix. |
| Amat | Item discrimination parameters. | A number of dimensions \* number of items matrix. |
| Dmat | Item boundary parameters. | A number of items vector. |
| Mu | Mean vector | A (number of dimensions \* number of groups) vector. Denote the number of dimensions r. The first r elements are for the first group, and the second r elements are for the second group, and so forth. |
| Sig | Covariance matrix | A (number of dimensions \* number of groups) \* number of dimension matrix. Denote the number of dimensions r. The first r rows are for the first group, and the second r rows are for the second group, and so forth. |
| ICs | BICs for all tuning parameters | A vector |
| IC | BIC for the selected tuning parameters | A scalar |
| domain | Number of dimensions | An integer |
| y | Number of groups | An integer |