**Table 1**

*Descriptive statistics of the participants in the Enem 2020 and the simulation samples*

|  |  |  |  |
| --- | --- | --- | --- |
| Area | n | Mean (standard deviation) | Range |
| Human Sciences |  |  |  |
| Participants in Enem | 2,749,073 | 0.09 (0.83) | -1.67–3.22 |
| Simulation sample | 2,268 | 0.06 (0.82) | -1.53–2.43 |
| Nature Sciences |  |  |  |
| Participants in Enem | 2,596,735 | -0.09 (0.70) | -1.57–3.13 |
| Simulation sample | 2,247 | -0.09 (0.71) | -1.48–2.51 |
| Languages and Codes |  |  |  |
| Participants in Enem | 2,751,791 | 0.22 (0.68) | -1.95–2.79 |
| Simulation sample | 2,649 | 0.22 (0.67) | -1.79–2.07 |
| Mathematics |  |  |  |
| Participants in Enem | 2,596,527 | 0.16 (0.90) | -1.33–3.66 |
| Simulation sample | 2,376 | 0.14 (0.90) | -1.33–3.35 |

**Table 2**

*Description of the four item banks*

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| Area | n | mean (standard deviation) | | |
|  |  | a | b | c |
| HS | 756 | 2,18 (0,95) | 1,09 (0,80) | 0,17 (0,07) |
| NS | 749 | 2,34 (1,01) | 1,39 (2,35) | 0,17 (0,07) |
| LC | 883 | 2,21 (0,9) | 0,79 (0,82) | 0,16 (0,07) |
| MT | 792 | 2,09 (0,78) | 1,97 (1,33) | 0,16 (0,06) |

**Table 3**

*Average of the minimum, maximum, mean, and median values of items administered in the simulations*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Stopping rule | Selection method | HS | | | | NS | | | | LC | | | | MT | | | |
|  |  | Min | Max | NIA | MIA | Min | Max | NIA | MIA | Min | Max | NIA | MIA | Min | Max | NIA | MIA |
| SE30 | RAN | 15.0 | 60.0 | 45.1 | 56.6 | 15.0 | 60.0 | 50.8 | 60.0 | 15.0 | 60.0 | 33.5 | 27.2 | 15.4 | 60.0 | 54.6 | 60.0 |
| MFI | 15.0 | 60.0 | 21.7 | 15.0 | 15.0 | 60.0 | 20.7 | 15.0 | 15.0 | 60.0 | 16.5 | 15.0 | 15.0 | 60.0 | 31.2 | 20.0 |
| PR2 | 15.0 | 60.0 | 26.9 | 19.0 | 15.0 | 60.0 | 29.6 | 24.0 | 15.0 | 60.0 | 19.6 | 15.0 | 15.0 | 60.0 | 40.5 | 40.1 |
| PR3 | 15.0 | 60.0 | 31.2 | 26.3 | 15.0 | 60.0 | 34.7 | 33.3 | 15.0 | 60.0 | 18.3 | 15.0 | 15.0 | 60.0 | 44.2 | 46.1 |
| ER015 | RAN | 15.0 | 21.4 | 15.4 | 15.0 | 15.0 | 20.7 | 15.3 | 15.0 | 15.0 | 20.9 | 15.5 | 15.0 | 15.0 | 20.8 | 15.3 | 15.0 |
| MFI | 15.0 | 18.9 | 15.1 | 15.0 | 15.0 | 19.1 | 15.1 | 15.0 | 15.0 | 18.6 | 15.0 | 15.0 | 15.0 | 19.5 | 15.2 | 15.0 |
| PR2 | 15.0 | 22.1 | 15.4 | 15.0 | 15.0 | 22.4 | 15.5 | 15.0 | 15.0 | 19.4 | 15.1 | 15.0 | 15.0 | 23.5 | 15.7 | 15.0 |
| PR3 | 15.0 | 21.9 | 15.5 | 15.0 | 15.0 | 21.6 | 15.4 | 15.0 | 15.0 | 19.0 | 15.1 | 15.0 | 15.0 | 22.5 | 15.5 | 15.0 |

Note. HS = Human Sciences; NS = Natural Sciences; LC = Languages and Codes; MT = Mathematics; NIA = average number of items administered; Min = minimum; Max = maximum; MIA = median of items administered; RAN = random; MFI = Maximum Fisher Information; PR2 = progressive-restricted with ; PR3 = progressive-restricted with ; SE30 = standard error of 0.30; ER015 = standard error of 0.30 or error reduction of 0.015.

**Table 4**

*Average of standard error, correlation, bias, and root mean squared error of the replications of fixed-length CATs*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Stopping rule | Selection method | HS | | | | NS | | | | LC | | | | MT | | | |
|  |  | SE | COR | Bias | RMSE | SE | COR | Bias | RMSE | SE | COR | Bias | RMSE | SE | COR | Bias | RMSE |
| FL45 | RAN | 0.370 | 0.918 | 0.053 | 0.340 | 0.423 | 0.870 | 0.066 | 0.372 | 0.271 | 0.929 | 0.045 | 0.268 | 0.510 | 0.880 | 0.078 | 0.439 |
| MFI | 0.176 | 0.976 | 0.021 | 0.186 | 0.183 | 0.967 | 0.025 | 0.189 | 0.129 | 0.981 | 0.010 | 0.134 | 0.241 | 0.965 | 0.035 | 0.243 |
| PR1 | 0.200 | 0.969 | 0.024 | 0.208 | 0.224 | 0.953 | 0.031 | 0.227 | 0.189 | 0.960 | 0.021 | 0.197 | 0.288 | 0.954 | 0.042 | 0.281 |
| PR2 | 0.211 | 0.967 | 0.026 | 0.217 | 0.232 | 0.950 | 0.032 | 0.233 | 0.187 | 0.961 | 0.021 | 0.194 | 0.297 | 0.952 | 0.045 | 0.287 |
| FL20 | RAN | 0.496 | 0.857 | 0.060 | 0.436 | 0.552 | 0.782 | 0.065 | 0.463 | 0.398 | 0.860 | 0.076 | 0.378 | 0.639 | 0.805 | 0.088 | 0.544 |
| MFI | 0.240 | 0.960 | 0.029 | 0.239 | 0.242 | 0.948 | 0.032 | 0.238 | 0.185 | 0.964 | 0.019 | 0.187 | 0.311 | 0.947 | 0.046 | 0.299 |
| PR1 | 0.269 | 0.951 | 0.034 | 0.264 | 0.284 | 0.932 | 0.039 | 0.273 | 0.209 | 0.955 | 0.023 | 0.209 | 0.360 | 0.933 | 0.053 | 0.337 |
| PR2 | 0.285 | 0.947 | 0.035 | 0.275 | 0.300 | 0.926 | 0.042 | 0.285 | 0.218 | 0.952 | 0.024 | 0.217 | 0.376 | 0.928 | 0.058 | 0.347 |

Note. HS = Human Sciences; NS = Natural Sciences; LC = Languages and Codes; MT = Mathematics; SE = standard error; COR = correlation; RMSE = root mean square error; RAN = random; MFI = Maximum Fisher Information; PR1 = progressive-restricted with ; PR2 = progressive-restricted with ; FL20 = fixed-length (20 items); FL45 = fixed-length (45 items).

**Table 5**

*Mean standard error, correlation, bias, and root mean square error of replications of variable-length CATs*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Stopping rule | Selection method | HS | | | | NS | | | | LC | | | | MT | | | |
|  |  | SE | COR | Bias | RMSE | SE | COR | Bias | RMSE | SE | COR | Bias | RMSE | SE | COR | Bias | RMSE |
| SE30 | RAN | 0.375 | 0.918 | 0.048 | 0.338 | 0.404 | 0.881 | 0.054 | 0.360 | 0.313 | 0.911 | 0.034 | 0.293 | 0.481 | 0.894 | 0.076 | 0.418 |
| MFI | 0.239 | 0.959 | 0.017 | 0.238 | 0.244 | 0.946 | 0.018 | 0.237 | 0.202 | 0.959 | 0.016 | 0.198 | 0.287 | 0.952 | 0.034 | 0.282 |
| PR2 | 0.274 | 0.947 | 0.019 | 0.270 | 0.286 | 0.925 | 0.015 | 0.278 | 0.240 | 0.943 | 0.020 | 0.233 | 0.333 | 0.940 | 0.043 | 0.317 |
| PR3 | 0.286 | 0.943 | 0.020 | 0.279 | 0.294 | 0.921 | 0.015 | 0.287 | 0.231 | 0.947 | 0.018 | 0.224 | 0.342 | 0.937 | 0.048 | 0.323 |
| ER015 | RAN | 0.540 | 0.828 | 0.064 | 0.474 | 0.594 | 0.745 | 0.064 | 0.494 | 0.446 | 0.829 | 0.088 | 0.420 | 0.682 | 0.772 | 0.095 | 0.583 |
| MFI | 0.268 | 0.952 | 0.032 | 0.261 | 0.264 | 0.940 | 0.034 | 0.257 | 0.211 | 0.955 | 0.022 | 0.209 | 0.334 | 0.941 | 0.048 | 0.316 |
| PR2 | 0.384 | 0.910 | 0.055 | 0.354 | 0.434 | 0.862 | 0.068 | 0.381 | 0.270 | 0.928 | 0.038 | 0.268 | 0.519 | 0.874 | 0.077 | 0.450 |
| PR3 | 0.469 | 0.868 | 0.061 | 0.420 | 0.538 | 0.792 | 0.072 | 0.453 | 0.254 | 0.936 | 0.031 | 0.251 | 0.628 | 0.808 | 0.088 | 0.541 |

Note. HS = Human Sciences; NS = Natural Sciences; LC = Languages and Codes; MT = Mathematics; SE = standard error; COR = correlation; RMSE = root mean square error; RAN = random; MFI = Maximum Fisher Information; PR2 = progressive-restricted with ; PR3 = progressive-restricted with ; SE30 = standard error of 0.30; ER015 = standard error of 0.30 or error reduction of 0.015.

**Table 6**

*Mean of the minimum and maximum exposure rates and item overlap rate in fixed-length CATs*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Stopping rule | Selection method | HS | | | NS | | | LC | | | MT | | |
|  |  | rmin | rmax | O | rmin | rmax | O | rmin | rmax | O | rmin | rmax | O |
| FL45 | RAN | 0.037 | 0.092 | 0.061 | 0.038 | 0.089 | 0.062 | 0.014 | 0.098 | 0.056 | 0.035 | 0.098 | 0.059 |
| MFI | 0.000 | 1.000 | 0.335 | 0.000 | 1.000 | 0.419 | 0.000 | 1.000 | 0.279 | 0.000 | 1.000 | 0.432 |
| PR1 | 0.004 | 0.300 | 0.174 | 0.005 | 0.300 | 0.182 | 0.002 | 0.300 | 0.155 | 0.005 | 0.300 | 0.181 |
| PR2 | 0.010 | 0.300 | 0.143 | 0.012 | 0.300 | 0.151 | 0.004 | 0.300 | 0.128 | 0.011 | 0.300 | 0.149 |
| FL20 | RAN | 0.015 | 0.040 | 0.027 | 0.015 | 0.041 | 0.027 | 0.006 | 0.039 | 0.024 | 0.014 | 0.038 | 0.026 |
| MFI | 0.000 | 1.000 | 0.323 | 0.000 | 1.000 | 0.383 | 0.000 | 1.000 | 0.264 | 0.000 | 1.000 | 0.404 |
| PR1 | 0.001 | 0.300 | 0.143 | 0.001 | 0.300 | 0.156 | 0.000 | 0.300 | 0.120 | 0.001 | 0.300 | 0.157 |
| PR2 | 0.002 | 0.300 | 0.110 | 0.003 | 0.300 | 0.122 | 0.001 | 0.299 | 0.091 | 0.003 | 0.300 | 0.125 |

Note. HS = Human Sciences; NS = Natural Sciences; LC = Languages and Codes; MT = Mathematics; rmin = minimum mean item exposure rate; rmax = maximum mean item exposure rate; O = mean overlap; RAN = random; MFI = Maximum Fisher Information; PR1 = progressive-restricted with ; PR2 = progressive-restricted with ; FL20 = fixed-length (20 items); FL45 = fixed-length (45 items).

**Table 7**

*Mean of the minimum and maximum exposure rates and item overlap rate in variable-length CATs*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Stopping rule | Selection method | HS | | | NS | | | LC | | | MT | | |
|  |  | rmin | rmax | O | rmin | rmax | O | rmin | rmax | O | rmin | rmax | O |
| SE30 | RAN | 0.036 | 0.096 | 0.061 | 0.040 | 0.105 | 0.070 | 0.009 | 0.075 | 0.042 | 0.041 | 0.131 | 0.072 |
| MFI | 0.000 | 1.000 | 0.299 | 0.000 | 1.000 | 0.340 | 0.000 | 1.000 | 0.265 | 0.000 | 1.000 | 0.406 |
| PR1 | 0.005 | 0.300 | 0.119 | 0.007 | 0.300 | 0.127 | 0.000 | 0.300 | 0.148 | 0.007 | 0.300 | 0.167 |
| PR2 | 0.011 | 0.299 | 0.095 | 0.014 | 0.300 | 0.103 | 0.000 | 0.300 | 0.125 | 0.014 | 0.300 | 0.139 |
| ER015 | RAN | 0.011 | 0.031 | 0.021 | 0.011 | 0.032 | 0.021 | 0.004 | 0.030 | 0.019 | 0.011 | 0.029 | 0.020 |
| MFI | 0.000 | 1.000 | 0.335 | 0.000 | 1.000 | 0.389 | 0.000 | 1.000 | 0.284 | 0.000 | 1.000 | 0.406 |
| PR1 | 0.004 | 0.217 | 0.047 | 0.006 | 0.177 | 0.042 | 0.000 | 0.300 | 0.151 | 0.006 | 0.127 | 0.033 |
| PR2 | 0.008 | 0.109 | 0.025 | 0.010 | 0.073 | 0.023 | 0.000 | 0.300 | 0.125 | 0.009 | 0.045 | 0.021 |

Note. HS = Human Sciences; NS = Natural Sciences; LC = Languages and Codes; MT = Mathematics; rmin = minimum mean item exposure rate; rmax = maximum mean item exposure rate; O = mean overlap; RAN = random; MFI = Maximum Fisher Information; PR2 = progressive-restricted with ; PR3 = progressive-restricted with ; SE30 = standard error of 0.30; ER015 = standard error of 0.30 or error reduction of 0.015.

**Table 8**

*Overall average percentages of items for each exposure rate interval in fixed-length CATs*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | HS | | | | NS | | | | LC | | | | MT | | | |
| Stopping rule | Exposure | RAN | MFI | PR1 | PR2 | RAN | MFI | PR1 | PR2 | RAN | MFI | PR1 | PR2 | RAN | MFI | PR1 | PR2 |
| FL20 | 0 | 0.0 | 79.8 | 0.0 | 0.0 | 0.0 | 80.2 | 0.0 | 0.0 | 0.0 | 74.5 | 0.0 | 0.0 | 0.0 | 82.6 | 0.0 | 0.0 |
| (0;0.02] | 0.0 | 6.7 | 78.7 | 76.1 | 0.0 | 7.7 | 80.6 | 78.8 | 24.3 | 9.7 | 80.1 | 77.3 | 0.0 | 5.8 | 81.6 | 80.4 |
| (0.02;0.05] | 100.0 | 2.4 | 9.3 | 12.8 | 100.0 | 2.7 | 8.0 | 11.3 | 75.7 | 5.0 | 8.4 | 11.9 | 100.0 | 2.7 | 7.4 | 9.2 |
| (0.05;0.1] | 0.0 | 2.1 | 4.4 | 5.0 | 0.0 | 1.6 | 3.9 | 3.3 | 0.0 | 2.0 | 4.5 | 5.2 | 0.0 | 2.0 | 3.5 | 4.4 |
| (0.1;0.15] | 0.0 | 2.4 | 2.5 | 2.1 | 0.0 | 1.6 | 1.9 | 2.0 | 0.0 | 3.5 | 3.5 | 2.7 | 0.0 | 1.5 | 2.1 | 1.5 |
| (0.15;0.2] | 0.0 | 1.3 | 1.7 | 1.7 | 0.0 | 0.8 | 1.3 | 1.5 | 0.0 | 1.2 | 1.4 | 1.6 | 0.0 | 1.3 | 1.5 | 1.4 |
| (0.2;0.25] | 0.0 | 1.3 | 1.5 | 0.9 | 0.0 | 0.9 | 1.6 | 1.3 | 0.0 | 1.2 | 0.9 | 1.0 | 0.0 | 0.6 | 0.8 | 1.3 |
| (0.25;0.3] | 0.0 | 1.5 | 1.6 | 1.3 | 0.0 | 1.2 | 2.7 | 1.7 | 0.0 | 1.0 | 1.2 | 0.2 | 0.0 | 0.3 | 2.5 | 1.6 |
| (0.3;0.4] | 0.0 | 1.2 | 0.4 | 0.0 | 0.0 | 1.1 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 | 0.9 | 0.5 | 0.1 |
| (0.4;1] | 0.0 | 1.3 | 0.0 | 0.0 | 0.0 | 2.1 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 2.4 | 0.0 | 0.0 |
|  |  | HS | | | | NS | | | | LC | | | | MT | | | |
|  | Exposure | RAN | MFI | PR1 | PR2 | RAN | MFI | PR1 | PR2 | RAN | MFI | PR1 | PR2 | RAN | MFI | PR1 | PR2 |
| FL45 | 0 | 0.0 | 59.1 | 0.0 | 0.0 | 0.0 | 60.2 | 0.0 | 0.0 | 0.0 | 57.1 | 0.0 | 0.0 | 0.0 | 62.4 | 0.0 | 0.0 |
| (0;0.02] | 0.0 | 12.8 | 48.5 | 21.3 | 0.0 | 15.8 | 53.4 | 11.9 | 2.3 | 13.6 | 52.9 | 35.9 | 0.0 | 13.6 | 55.2 | 18.6 |
| (0.02;0.05] | 11.6 | 4.9 | 22.8 | 50.4 | 13.2 | 4.4 | 20.4 | 62.1 | 37.9 | 5.2 | 20.2 | 38.7 | 25.8 | 5.1 | 19.8 | 57.8 |
| (0.05;0.1] | 88.4 | 4.6 | 11.0 | 13.0 | 86.8 | 3.2 | 7.9 | 11.5 | 59.8 | 6.7 | 11.9 | 13.3 | 74.2 | 5.2 | 8.8 | 10.4 |
| (0.1;0.15] | 0.0 | 3.4 | 4.1 | 4.9 | 0.0 | 2.5 | 4.8 | 3.7 | 0.0 | 4.1 | 4.6 | 3.9 | 0.0 | 1.8 | 3.3 | 3.2 |
| (0.15;0.2] | 0.0 | 3.2 | 3.6 | 2.8 | 0.0 | 2.9 | 2.7 | 2.8 | 0.0 | 2.8 | 3.3 | 2.9 | 0.0 | 1.6 | 2.3 | 2.1 |
| (0.2;0.25] | 0.0 | 2.0 | 2.6 | 2.1 | 0.0 | 1.9 | 2.4 | 1.2 | 0.0 | 3.7 | 2.2 | 1.9 | 0.0 | 1.8 | 2.3 | 1.5 |
| (0.25;0.3] | 0.0 | 2.4 | 5.8 | 4.4 | 0.0 | 1.6 | 8.4 | 6.8 | 0.0 | 1.9 | 4.6 | 3.2 | 0.0 | 1.3 | 5.7 | 4.4 |
| (0.3;0.4] | 0.0 | 3.4 | 1.6 | 1.2 | 0.0 | 1.9 | 0.0 | 0.0 | 0.0 | 2.6 | 0.3 | 0.2 | 0.0 | 2.0 | 2.7 | 2.0 |
| (0.4;1] | 0.0 | 4.1 | 0.0 | 0.0 | 0.0 | 5.6 | 0.0 | 0.0 | 0.0 | 2.3 | 0.0 | 0.0 | 0.0 | 5.3 | 0.0 | 0.0 |

Note. HS = Human Sciences; NS = Natural Sciences; LC = Languages and Codes; MT = Mathematics; RAN = random; MFI = Maximum Fisher Information; PR1 = progressive-restricted with ; PR2 = progressive-restricted with ; FL20 = fixed-length (20 items); FL45 = fixed-length (45 items).

**Table 9**

*Overall average percentages of items for each exposure rate interval in variable-length CATs*

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  |  | HS | | | | NS | | | | LC | | | | MT | | | |
| Stopping rule | Exposure | RAN | MFI | PR2 | PR3 | RAN | MFI | PR2 | PR3 | RAN | MFI | PR2 | PR3 | RAN | MFI | PR2 | PR3 |
| SE30 | 0 | 0.0 | 75.1 | 0.0 | 0.0 | 0.0 | 76.4 | 0.0 | 0.0 | 0.0 | 71.2 | 0.0 | 0.0 | 0.0 | 78.5 | 0.0 | 0.0 |
| (0;0.02] | 0.0 | 8.2 | 65.7 | 18.8 | 0.0 | 9.1 | 64.5 | 0.8 | 8.3 | 15.2 | 80.1 | 79.8 | 0.0 | 6.7 | 52.4 | 1.9 |
| (0.02;0.05] | 16.0 | 3.3 | 18.3 | 64.7 | 0.3 | 2.0 | 20.2 | 81.8 | 80.2 | 4.8 | 8.2 | 9.2 | 0.4 | 2.4 | 28.2 | 78.7 |
| (0.05;0.1] | 84.0 | 3.7 | 7.1 | 8.6 | 99.7 | 3.7 | 5.2 | 8.1 | 11.6 | 3.1 | 5.2 | 5.4 | 96.8 | 1.5 | 5.9 | 6.8 |
| (0.1;0.15] | 0.0 | 2.5 | 2.6 | 2.9 | 0.0 | 2.4 | 2.7 | 3.3 | 0.0 | 1.9 | 2.0 | 2.4 | 2.8 | 1.1 | 2.7 | 3.3 |
| (0.15;0.2] | 0.0 | 1.9 | 2.5 | 2.2 | 0.0 | 1.9 | 3.2 | 2.4 | 0.0 | 0.8 | 1.5 | 1.0 | 0.0 | 0.9 | 2.4 | 2.0 |
| (0.2;0.25] | 0.0 | 1.9 | 1.7 | 1.5 | 0.0 | 1.1 | 2.0 | 1.5 | 0.0 | 0.9 | 1.0 | 1.0 | 0.0 | 1.6 | 1.4 | 1.9 |
| (0.25;0.3] | 0.0 | 0.8 | 2.0 | 1.3 | 0.0 | 0.8 | 2.3 | 2.0 | 0.0 | 0.8 | 1.9 | 1.1 | 0.0 | 2.0 | 5.7 | 4.5 |
| (0.3;0.4] | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 | 0.9 | 0.0 | 0.0 | 0.0 | 0.6 | 0.1 | 0.0 | 0.0 | 1.8 | 1.4 | 0.9 |
| (0.4;1] | 0.0 | 1.5 | 0.0 | 0.0 | 0.0 | 1.7 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 3.4 | 0.0 | 0.0 |
| ER015 |  | HS | | | | NS | | | | LC | | | | MT | | | |
| Exposure | RAN | MFI | PR2 | PR3 | RAN | MFI | PR2 | PR3 | RAN | MFI | PR2 | PR3 | RAN | MFI | PR2 | PR3 |
| 0 | 0.0 | 85.3 | 0.0 | 0.0 | 0.0 | 85.0 | 0.0 | 0.0 | 0.0 | 81.4 | 0.0 | 0.0 | 0.0 | 87.4 | 0.0 | 0.0 |
| (0;0.02] | 39.2 | 4.0 | 74.3 | 70.0 | 41.8 | 6.0 | 76.0 | 68.5 | 67.0 | 7.8 | 86.3 | 85.1 | 69.4 | 4.0 | 76.0 | 70.6 |
| (0.02;0.05] | 60.8 | 2.1 | 18.9 | 27.6 | 58.2 | 1.6 | 18.0 | 30.3 | 33.0 | 2.4 | 4.8 | 6.1 | 30.6 | 2.0 | 17.6 | 29.4 |
| (0.05;0.1] | 0.0 | 2.1 | 5.0 | 2.1 | 0.0 | 1.2 | 3.9 | 1.2 | 0.0 | 2.6 | 3.6 | 4.5 | 0.0 | 1.0 | 5.6 | 0.0 |
| (0.1;0.15] | 0.0 | 1.5 | 1.1 | 0.3 | 0.0 | 1.7 | 1.6 | 0.0 | 0.0 | 2.0 | 1.8 | 1.2 | 0.0 | 1.3 | 0.9 | 0.0 |
| (0.15;0.2] | 0.0 | 1.2 | 0.5 | 0.0 | 0.0 | 0.5 | 0.5 | 0.0 | 0.0 | 0.7 | 0.8 | 1.1 | 0.0 | 1.1 | 0.0 | 0.0 |
| (0.2;0.25] | 0.0 | 0.9 | 0.1 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.9 | 1.2 | 1.0 | 0.0 | 0.3 | 0.0 | 0.0 |
| (0.25;0.3] | 0.0 | 1.1 | 0.0 | 0.0 | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 0.8 | 1.5 | 0.9 | 0.0 | 0.5 | 0.0 | 0.0 |
| (0.3;0.4] | 0.0 | 0.7 | 0.0 | 0.0 | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 | 0.6 | 0.0 | 0.0 | 0.0 | 1.0 | 0.0 | 0.0 |
| (0.4;1] | 0.0 | 1.2 | 0.0 | 0.0 | 0.0 | 1.3 | 0.0 | 0.0 | 0.0 | 0.8 | 0.0 | 0.0 | 0.0 | 1.4 | 0.0 | 0.0 |

Note. HS = Human Sciences; NS = Natural Sciences; LC = Languages and Codes; MT = Mathematics; RAN = random; MFI = Maximum Fisher Information; PR2 = progressive-restricted with ; PR3 = progressive-restricted with ; SE30 = standard error of 0.30; ER015 = standard error of 0.30 or error reduction of 0.015.

**Table 10**

*Mean of standard error, correlation, bias, and root mean square error of the replications of simulations with linear application and PR2FL20 condition of the CAT.*

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
|  | Linear | | | | PR2FL20 | | | |
|  | Standard Error | Correlation | Bias | RMSE | Standard Error | Correlation | Bias | RMSE |
| HS | 0,422 | 0,895 | -0,061 | 0,379 | 0,285 | 0,947 | 0,035 | 0,275 |
| NS | 0,451 | 0,860 | -0,078 | 0,386 | 0,300 | 0,926 | 0,042 | 0,285 |
| LC | 0,308 | 0,908 | -0,052 | 0,301 | 0,218 | 0,952 | 0,024 | 0,217 |
| MT | 0,495 | 0,885 | -0,077 | 0,433 | 0,376 | 0,928 | 0,058 | 0,347 |

Note. PR2FL20 = progressive-restricted with and fixed-length (20 items); RMSE = root mean square error.