Supplementary Material for: Estimating the sample mean and standard deviation from commonly reported quantiles in meta-analysis

Sean McGrath, XiaoFei Zhao, Russell Steele, Brett D. Thombs, Andrea Benedetti and the DEPRESsion Screening Data (DEPRESSD) Collaboration

**Section 1**

In this section, we present the results of the sensitivity analyses of the simulation study for scenarios $S\_{1}$ and $S\_{2}$. Figures S1 and S2 give the $S\_{1}$ and $S\_{2}$ simulation results, respectively, for non-normal distributions.

**Figure S1**: ARE of the Luo/Wan (red line, hollow circle), QE (blue line, solid triangle), and BC (green line, solid circle) methods in scenario $S\_{1}$ in the sensitivity analyses. The panels in the left and right columns present the ARE of the sample mean estimators and sample standard deviation estimators, respectively.

**Figure S2**: ARE of the Luo/Wan (red line, hollow circle), QE (blue line, solid triangle), and BC (green line, solid circle) methods in scenario $S\_{2}$ in the sensitivity analyses. The panels in the left and right columns present the ARE of the sample mean estimators and sample standard deviation estimators, respectively.

**Section 2**

In this section, we present the $S\_{3}$ simulation results. Figures S3 and S4 give the simulation results for the primary and sensitivity analyses, respectively.

**Figure S3**: ARE of the Luo/Wan (red line, hollow circle), QE (blue line, solid triangle), and BC (green line, solid circle) methods in scenario $S\_{3}$ in the primary analyses. The panels in the left and right columns present the ARE of the sample mean estimators and sample standard deviation estimators, respectively.

Note that for the Log-Normal(5,1) distribution, the QE standard deviation estimator had $ARE=1.70$ when $n=25$.

**Figure S4**: ARE of the Luo/Wan (red line, hollow circle), QE (blue line, solid triangle), and BC (green line, solid circle) methods in scenario $S\_{3}$ in the sensitivity analyses. The panels in the left and right columns present the ARE of the sample mean estimators and sample standard deviation estimators, respectively.

**Section 3**

In this section, we present the results of the simulation study when normal distributions were used to generate data. For these simulations, recall that the QE method has candidate distributions including the normal distribution as well as several distributions with a strictly positive support. Therefore, a negative minimum value (in $S\_{1}$ or $S\_{3}$) or a negative first quartile value (in $S\_{2}$) would bias QE model selection towards the normal distribution. Additionally, as described in the Example, the QE method implicitly assumes that the extracted summary data are strictly positive when fitting the log-normal distribution. Therefore, when applying all methods to data sampled from the normal distribution, if the extracted summary data included a negative value, the data were shifted so that the minimum value (in $S\_{1}$ or $S\_{3}$) or the first quartile value (in $S\_{2}$) equaled 0.5. Let $c$ denote the value of such a shift. After estimating the sample mean, a value of $c$ was subtract from the sample mean.

Figures S5 and S6 give the simulation results for the primary and sensitivity analyses, respectively.

**Figure S5**: ARE of the Luo/Wan (red line, hollow circle), QE (blue line, solid triangle), and BC (green line, solid circle) methods in scenario $S\_{1}$ (top row), $S\_{2}$ (middle row), and $S\_{3}$ (bottom row) when applied to normally distributed data in the primary analyses. The panels in the left and right columns present the ARE of the sample mean estimators and sample standard deviation estimators, respectively.

**Figure S6**: ARE of the Luo/Wan (red line, hollow circle), QE (blue line, solid triangle), and BC (green line, solid circle) methods in scenario $S\_{1}$ (top row), $S\_{2}$ (middle row), and $S\_{3}$ (bottom row) when applied to normally distributed data in the sensitivity analyses. The panels in the left and right columns present the ARE of the sample mean estimators and sample standard deviation estimators, respectively.

**Section 4**

In this section, we present all simulation results when using the relative mean squared error (RMSE) as the performance measure. Figures S7, S8, and S9 give the results of the primary analyses of the simulation study in scenarios $S\_{1}$, $S\_{2}$, and $S\_{3}$, respectively. Figures S10, S11, and S12 give the results of the sensitivity analyses of the simulation study in scenarios $S\_{1}$, $S\_{2}$, and $S\_{3}$, respectively. Figures S13 and S14 give the results of the primary and sensitivity analyses, respectively, when normal distributions were used to generate data.

**Figure S7**: RMSE of the Luo/Wan (red line, hollow circle), QE (blue line, solid triangle), and BC (green line, solid circle) methods in scenario $S\_{1}$ in the primary analyses. The panels in the left and right columns present the RMSE of the sample mean estimators and sample standard deviation estimators, respectively.

**Figure S8**: RMSE of the Luo/Wan (red line, hollow circle), QE (blue line, solid triangle), and BC (green line, solid circle) methods in scenario $S\_{2}$ in the primary analyses. The panels in the left and right columns present the RMSE of the sample mean estimators and sample standard deviation estimators, respectively.

**Figure S9**: RMSE of the Luo/Wan (red line, hollow circle), QE (blue line, solid triangle), and BC (green line, solid circle) methods in scenario $S\_{3}$ in the primary analyses. The panels in the left and right columns present the RMSE of the sample mean estimators and sample standard deviation estimators, respectively.

For the Log-Normal(5,1) distribution, the QE sample standard deviation estimator had RMSE of 4,518.23 when $n=25$.

**Figure S10**: RMSE of the Luo/Wan (red line, hollow circle), QE (blue line, solid triangle), and BC (green line, solid circle) methods in scenario $S\_{1}$ in the sensitivity analyses. The panels in the left and right columns present the RMSE of the sample mean estimators and sample standard deviation estimators, respectively.

**Figure S11**: RMSE of the Luo/Wan (red line, hollow circle), QE (blue line, solid triangle), and BC (green line, solid circle) methods in scenario $S\_{2}$ in the sensitivity analyses. The panels in the left and right columns present the RMSE of the sample mean estimators and sample standard deviation estimators, respectively.

**Figure S12**: RMSE of the Luo/Wan (red line, hollow circle), QE (blue line, solid triangle), and BC (green line, solid circle) methods in scenario $S\_{3}$ in the sensitivity analyses. The panels in the left and right columns present the RMSE of the sample mean estimators and sample standard deviation estimators, respectively.

**Figure S13**: RMSE of the Luo/Wan (red line, hollow circle), QE (blue line, solid triangle), and BC (green line, solid circle) methods in scenario $S\_{1}$ (top row), $S\_{2}$ (middle row), and $S\_{3}$ (bottom row) when applied to normally distributed data in the primary analyses. The panels in the left and right columns present the RMSE of the sample mean estimators and sample standard deviation estimators, respectively.

**Figure S14**: RMSE of the Luo/Wan (red line, hollow circle), QE (blue line, solid triangle), and BC (green line, solid circle) methods in scenario $S\_{1}$ (top row), $S\_{2}$ (middle row), and $S\_{3}$ (bottom row) when applied to normally distributed data in the sensitivity analyses. The panels in the left and right columns present the RMSE of the sample mean estimators and sample standard deviation estimators, respectively.

**Section 5**

**Table S1**: The sample minimum value ($Q\_{min}$), first quartile ($Q\_{1}$), median ($Q\_{2}$), third quartile ($Q\_{3}$), maximum value ($Q\_{max}$), and sample size ($n$) of the 58 primary studies in the individual patient data meta-analysis of mean PHQ-9 scores.

|  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- |
| Study | $Q\_{min}$  | $Q\_{1}$  | $Q\_{2}$  | $Q\_{3}$  | $Q\_{max}$  | $n$  |
| Persoons et al. 2001 | 0.00 | 2.00 | 5.00 | 9.00 | 27.00 | 173 |
| Henkel et al. 2004 | 0.00 | 3.00 | 5.00 | 10.00 | 25.00 | 430 |
| Grafe et al. 2004 | 0.00 | 3.00 | 7.00 | 12.00 | 27.00 | 494 |
| Fann et al. 2005 | 0.00 | 0.00 | 4.00 | 8.50 | 24.00 | 135 |
| Picardi et al. 2005 | 0.00 | 2.00 | 5.00 | 10.00 | 25.00 | 138 |
| Azah et al. 2005 | 0.00 | 3.00 | 5.00 | 8.00 | 21.00 | 180 |
| Hahn et al. 2006 | 0.00 | 5.50 | 9.00 | 14.00 | 26.00 | 211 |
| Eack et al. 2006 | 1.00 | 4.00 | 9.00 | 16.25 | 24.00 |  48 |
| Muramatsu et al. 2007 | 0.00 | 3.00 | 7.00 | 13.00 | 27.00 | 116 |
| Stafford et al. 2007 | 0.00 | 1.00 | 3.00 | 7.00 | 27.00 | 193 |
| Hides et al. 2007 | 0.00 | 6.00 | 13.00 | 18.50 | 27.00 | 103 |
| Patel et al. 2008 | 0.00 | 1.00 | 4.00 | 7.00 | 27.00 | 299 |
| Thombs et al. 2008 | 0.00 | 1.00 | 3.00 | 8.00 | 25.00 | 1006 |
| Lotrakul et al. 2008 | 0.00 | 3.00 | 6.00 | 9.00 | 24.00 | 278 |
| Lamers et al. 2008 | 0.00 | 3.00 | 5.00 | 12.00 | 27.00 | 104 |
| Wittkampf et al. 2009 | 0.00 | 1.00 | 4.00 | 9.00 | 27.00 | 260 |
| Osorio et al. 2009 | 0.00 | 1.00 | 5.00 | 14.00 | 24.00 | 177 |
| Gjerdingen et al. 2009 | 0.00 | 1.00 | 3.00 | 6.00 | 27.00 | 419 |
| Richardson et al. 2010 | 0.00 | 3.00 | 7.00 | 11.00 | 27.00 | 377 |
| van Steenbergen-Weijenburg et al. 2010 | 0.00 | 2.00 | 7.50 | 12.00 | 27.00 | 196 |
| Arroll et al. 2010 | 0.00 | 1.00 | 3.00 | 6.00 | 27.00 | 2528 |
| Ayalon et al. 2010 | 0.00 | 0.00 | 2.00 | 5.00 | 24.00 | 151 |
| Delgadillo et al. 2011 | 0.00 | 10.00 | 13.00 | 17.50 | 27.00 | 103 |
| Hyphantis et al. 2011 | 0.00 | 2.00 | 5.00 | 9.50 | 23.00 | 213 |
| Hobfoll et al. 2011 | 0.00 | 1.00 | 4.00 | 10.00 | 26.00 | 144 |
| Khamseh et al. 2011 | 0.00 | 6.00 | 11.00 | 19.00 | 27.00 | 184 |
| Liu et al. 2011 | 0.00 | 0.00 | 2.00 | 5.00 | 25.00 | 1532 |
| Pence et al. 2012 | 0.00 | 0.00 | 1.00 | 4.00 | 19.00 | 398 |
| Osorio et al. 2012 | 0.00 | 4.25 | 9.00 | 15.75 | 27.00 |  86 |
| Mohd Sidik et al. 2012 | 0.00 | 2.00 | 3.00 | 7.00 | 21.00 | 146 |
| Bombardier et al. 2012 | 0.00 | 2.00 | 5.00 | 10.00 | 27.00 | 160 |
| Sidebottom et al. 2012 | 0.00 | 2.00 | 5.00 | 9.00 | 26.00 | 246 |
| Turner et al. 2012 | 0.00 | 2.75 | 6.00 | 10.00 | 26.00 |  72 |
| Williams et al. 2012 | 0.00 | 2.00 | 5.00 | 8.00 | 21.00 | 235 |
| de Man-van Ginkel et al. 2012 | 0.00 | 3.00 | 6.00 | 10.00 | 23.00 | 164 |
| Simning et al. 2012 | 0.00 | 2.00 | 4.00 | 7.75 | 21.00 | 190 |
| Kwan et al. 2012 | 0.00 | 2.00 | 4.00 | 8.00 | 27.00 | 113 |
| Sung et al. 2013 | 0.00 | 1.00 | 3.00 | 6.00 | 27.00 | 399 |
| Inagaki et al. 2013 | 0.00 | 0.00 | 2.00 | 3.19 | 22.00 | 104 |
| Razykov et al. 2013 | 0.00 | 3.00 | 6.00 | 10.00 | 26.00 | 345 |
| Rooney et al. 2013 | 0.00 | 3.00 | 5.00 | 9.00 | 25.00 | 126 |
| Vohringer et al. 2013 | 0.00 | 5.00 | 8.00 | 14.00 | 27.00 | 190 |
| Zhang et al. 2013 | 0.00 | 2.00 | 5.00 | 10.00 | 26.00 |  68 |
| Twist et al. 2013 | 0.00 | 0.00 | 2.00 | 7.00 | 27.00 | 360 |
| Chagas et al. 2013 | 0.00 | 4.00 | 7.50 | 12.00 | 23.00 |  84 |
| Akena et al. 2013 | 0.00 | 2.00 | 6.00 | 9.00 | 23.00 |  91 |
| Santos et al. 2013 | 0.00 | 1.00 | 4.00 | 8.00 | 21.00 | 196 |
| McGuire et al. 2013 | 0.00 | 1.00 | 4.00 | 8.50 | 23.00 | 100 |
| Fischer et al. 2014 | 0.00 | 1.00 | 4.00 | 8.00 | 27.00 | 194 |
| Gelaye et al. 2014 | 0.00 | 2.00 | 5.00 | 10.00 | 27.00 | 923 |
| Beraldi et al. 2014 | 0.00 | 3.00 | 6.00 | 8.00 | 16.00 | 116 |
| Cholera et al. 2014 | 0.00 | 2.00 | 5.00 | 9.00 | 22.00 | 397 |
| Fiest et al. 2014 | 0.00 | 1.00 | 4.00 | 9.00 | 26.00 | 169 |
| Hyphantis et al. 2014 | 0.00 | 2.00 | 5.00 | 10.00 | 27.00 | 349 |
| Kiely et al. 2014 | 0.00 | 1.00 | 3.00 | 6.00 | 27.00 | 822 |
| Lambert et al. 2015 | 0.00 | 2.00 | 6.00 | 10.00 | 24.00 | 147 |
| Amoozegar et al. 2017 | 0.00 | 3.00 | 7.00 | 12.00 | 27.00 | 203 |
| Turner et al. Unpublished | 0.00 | 0.50 | 3.00 | 5.00 | 24.00 |  51 |