

## Manual for web application $p$ -uniform

<https://rvanaert.shinyapps.io/p-uniform>

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Meta-analysis based on  $p$ -uniform can be conducted by means of this web application.<sup>1</sup>  $P$ -uniform is a method for estimating effect size, testing the null-hypothesis of no effect, and testing for publication bias while taking into account publication bias. The  $p$ -uniform method is based on the statistical theory that the distribution of  $p$ -values is uniform conditional on the population effect size. For more information see van Assen, van Aert, and Wicherts (2015) or van Aert, Wicherts, and van Assen (2015).

The web application can currently handle three different effect size measures: one-sample mean, two-independent means, and raw correlation coefficients.

### Step-by-step guide for using the web application:

- 1) Select the effect size measure in the meta-analysis (one-sample mean, two-independent means, or one raw correlation).
- 2) Select the alpha level which is used in the primary studies. The default alpha level is .05. Note that  $p$ -uniform assumes that two-tailed tests were conducted in the primary studies. If one-tailed hypothesis tests were used in the primary studies, the alpha level has to be multiplied by two before applying  $p$ -uniform.
- 3) Select whether the effect sizes in the primary studies are in the right-tail of the distribution (i.e., positive effects) or in the left-tail of the distribution (i.e., negative effects).
- 4) Select the type of estimator to be used by  $p$ -uniform. The P method is based on the distribution of the sum of independent uniformly distributed random variables (Irwin-Hall distribution) and is the recommended estimator (van Aert et al., 2015). The LNP estimator refers to Fisher's method (1950, Chapter 4) for combining  $p$ -values and the LN1MINP estimator first computes  $1 - p$ -value in each study before applying Fisher's method on these transformed  $p$ -values (van Assen, van Aert, & Wicherts, 2014). KS and AD respectively use the Kolmogorov-Smirnov test (Massey, 1951) and the Anderson-Darling test (Anderson & Darling, 1954) for testing whether the (conditional)  $p$ -values follow a uniform distribution.
- 5) Two options are available for entering the data in the web application. Data can be entered via a CSV file or manually in a table in the web browser.

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<sup>1</sup> This web application is based on the R package `puniform` which can be downloaded from GitHub by running the following lines of code inside R: `devtools::install_github("RobbievanAert/puniform"); library(puniform)`

### Manually in table:

If “Manually in table” is selected, you can choose between supplying  $p$ -uniform with  $t$ -statistics and sample sizes for each primary study (only for one-sample mean and two-independent means) or with descriptive statistics. Note that extra rows can be added to the table by clicking the “plus” sign above the table. The following information has to be entered:

For one-sample mean based on  $t$ -statistics:

- $tobs$  →  $t$ -statistic for each primary study
- $ni$  → sample size for each primary study

For one-sample mean based on descriptive statistics:

- $mi$  → group mean for each primary study
- $ni$  → sample mean for each primary study
- $sd_i$  → standard deviation for each primary study

For two-independent means based on  $t$ -statistics:

- $tobs$  →  $t$ -statistic for each primary study
- $n1i$  → sample size in group 1 for each primary study
- $n2i$  → sample size in group 2 for each primary study

For two-independent means based on descriptive statistics:

- $m1i$  → mean in group 1 for each primary study
- $m2i$  → mean in group 2 for each primary study
- $n1i$  → sample size in group 1 for each primary study
- $n2i$  → sample size in group 2 for each primary study
- $sd1i$  → standard deviation in group 1 for each primary study
- $sd2i$  → standard deviation in group 2 for each primary study

For one correlation:

- $ri$  → raw correlation coefficient for each primary study
- $ni$  → sample size for each primary study

### Via CSV file:

If “via CSV file” is selected, a comma separated file has to be uploaded with a comma as separator and a period indicating the decimal point. The first row should *exactly* match the names of the variables as described above for supplying the data manually in the table. To give an example, the CSV file for two-independent means has to be structured as follows

For  $t$ -statistics:

	A	B	C
1	tobs	n1i	n2i
2	4	200	200
3	4	200	200

For descriptive statistics:

	A	B	C	D	E	F
1	m1i	m2i	n1i	n2i	sd1i	sd2i
2	0.2	0	200	200	1	1
3	0.2	0	200	200	1	1

- 6) By clicking the “Analyze” button  $p$ -uniform is applied to your data.
- 7) The output can be saved as .pdf by clicking the “Download Output as .pdf” button.

## References

- Anderson, T. W., & Darling, D. A. (1954). A test of goodness of fit. *Journal of the American Statistical Association*, 49(268), 765-769.
- Fisher, R. A. (1950). *Statistical methods for research workers* (11th ed.). London: Oliver & Boyd.
- Massey, F. J. (1951). The Kolmogorov-Smirnov test for goodness of fit. *Journal of the American Statistical Association*, 46(253), 68-78.
- van Aert, R. C. M., Wicherts, J. M., & van Assen, M. A. L. M. (2015). Conducting meta-analyses on  $p$ -values: Reservations and recommendations for applying  $p$ -uniform and  $p$ -curve. Manuscript in preparation.
- van Assen, M. A. L. M., van Aert, R. C. M., & Wicherts, J. M. (2015). Meta-analysis using effect size distributions of only statistically significant studies. *Psychological Methods*, 20(3), 293-309. doi:<http://dx.doi.org/10.1037/met0000025>