

Vignettes for the R-program

## **Confidence intervals for a random-effects meta-analysis based on Bartlett-type corrections**

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This program computes the estimates and confidence intervals of fixed-effects and random-effects meta-analyses. This program covers the following methods:

- (1) Fixed-effects model: Inverse variance weighted average (point estimate and confidence interval)
- (2) Random-effects model:
  - Point estimates by DerSimonian and Laird (1982) [method-of-moment] and the maximum likelihood estimate
  - Confidence intervals by
    - (a) The DerSimonian and Laird (1982) method
    - (b) The likelihood ratio statistic (Hardy and Thompson, 1996)
    - (c) The Bartlett corrected likelihood ratio statistic (Noma, 2011)
    - (d) The efficient score statistic (Noma, 2011)
    - (e) The Bartlett-type adjusted efficient score statistic (Noma, 2011)

where (c), (d) and (e) are the confidence intervals developed by the methods in this article.

The RData file includes a function **BMA** for computing these estimates and confidence intervals, and a sample dataset by Teo *et al.* (1991) in Section 5. The dataset by Teo *et al.* (1991) is summarized as **magnesium**.

```
> print(magnesium)
```

	OR	y	v
1	0.43589744	-0.83034830	1.5550528
2	0.34782609	-1.05605267	0.1714545
3	0.27849928	-1.27833981	0.6530890
4	0.95744681	-0.04348511	2.0434988
5	1.25000000	0.22314355	0.2392857
6	0.09003831	-2.40751999	1.1496291
7	0.27777778	-1.28093385	1.4250000

For implementing the **BMA** function, there are four arguments:

- **Y**: Outcome statistics of individual studies: log odds-ratio, log hazard-ratio, standardized mean difference, etc. (e.g., **y** of the above example)
- **V**: Estimated variances of these statistics. (e.g., **v** of the above example)
- **alpha**: The confidence level (default is 0.95).
- **Log**: A logical argument. If it is TRUE (e.g., **y** is inputted by log scale), the estimates are outputted by the transformed exponential. Default is FALSE.

For example, the result of Table 1 (except for Peto's method) is obtained by:

```
> y <- magnesium$y
> v <- magnesium$v

> BMA(Y=y, V=v, alpha=0.95, Log=TRUE)
```

```
Fixed-effects & random-effects meta-analysis
```

```
Point estimates:
```

```
Fixed-effects model: 0.471
DerSimonian-Laird (method-of-moment): 0.448
Maximum likelihood: 0.449
```

```
Variance component estimates:
```

```
DerSimonian-Laird (method-of-moment): 0.171
```

Maximum likelihood: 0.162

Confidence intervals:

Fixed-effects model: 0.28 0.791

DerSimonian-Laird (method-of-moment): 0.233 0.861

Likelihood ratio (LR): 0.192 0.903

Bartlett corrected LR: 0.158 1.066

Efficient score: 0.137 1.005

Bartlett-type adjusted score: 0.145 0.963

Confidence level: 0.95

### References

DerSimonian R, Larid NM. Meta-analysis in clinical trials. *Controlled Clinical Trials* 1986; **7**: 177-188.

Hardy RJ, Thompson SG. A likelihood approach to meta-analysis with random effects. *Statistics in Medicine* 1996; **15**: 619-629.

Noma, H. Confidence intervals for a random-effects meta-analysis based on Bartlett-type corrections. *Statistics in Medicine* 2011; **30**: 3304-3312.

Teo KK, Yusuf S, Collins R, Held PH, Peto R. Effects of intravenous magnesium in suspected acute myocardial infarction: overview of randomized trials. *British Medical Journal* 1991; **303**: 1499-1503.