

MAIVE in R:

Instructions to the User

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This document provides some instructions on the implementation of the MAIVE meta-analysis estimator in R.¹ The code consists of two files: *maive.r* and *maivefunction.r*. The execution file is *maive.r*, which internally calls *maivefunction.r*. Both files should be stored in the same folder.

1. Input

The code requires the user to supply the meta-analysis data in an Excel file to be called *inputdata.xlsx*, which should be in the same folder as the R files. The Excel file should have the following structure:

- Column 1, to be labelled ‘bs’, should contain the primary estimates.
- Column 2, to be labelled ‘sebs’, should contain the standard errors.
- Column 3, to be labelled ‘Ns’, should contain the sample sizes.
- Column 4, to be labelled ‘study_id’, should contain a study identification number. (This column is only necessary if the user chooses clustering or study-level fixed effects. See below.)

Figure 1 shows the structure of the input Excel file.

¹“Spurious Precision in Meta-Analysis,” by Zuzana Irsova, Pedro Bom, Tomas Havranek, and Heiko Rachinger.

Figure 1: Example of the input file with the meta-analysis data

	A	B	C	D	
1	bs	sebs	Ns	studyid	
2	2.4841	0.8427	58	4	
3	-2.2383	1.1934	38	3	
4	1.5497	0.5759	183	4	
5	0.5149	0.2603	930	9	
6	0.0755	0.5233	258	3	
7	0.9914	1.3905	30	7	
8	0.0449	0.2212	1389	5	
9	0.7615	0.3594	560	5	
10	0.4205	0.1769	2105	4	
11	0.6170	0.2845	629	2	
12	-0.2377	0.9119	83	9	
13	-0.3250	0.5504	201	5	
14	3.3882	1.1907	50	4	
15	1.2926	0.5684	169	8	
16	1.0893	0.5249	201	3	
17	0.2577	0.1941	1766	1	
18	1.5449	0.5761	185	10	
19	1.0222	0.4833	240	3	
20	-0.0677	0.3537	482	10	
21	0.2497	0.2218	1277	5	
22	1.9761	0.8772	95	3	

2. Options

The default MAIVE meta-estimator is MAIVE-PET-PEESE with instrumented standard errors and no weights. However, the user can choose other options in lines 28-39 of *maive.r*. The code allows for the user to change the meta-analysis method (PET, PEESE, PET-PEESE, or EK), the weighting (no weights, standard inverse-variance weights, or MAIVE-adjusted weights), the instrumentation of standard errors (yes or no), and the accounting for study-level correlation (none, study fixed effects, or cluster-robust methods).

- Method: PET=1, PEESE=2, PET-PEESE=3, EK=4. The default method option is PET-PEESE=3. This option can be changed in line 30 by inserting the corresponding number.
- Weighting: no weights=0, inverse-variance weights=1, adjusted weights=2. The default weighting option is no weights=0. This option can be changed in line 32 by inserting the corresponding number.
- Instrumenting the SEs: no=0, yes=1. The default instrumenting option is yes=1.

This option can be changed in line 34 by inserting the corresponding number.

- Study-level correlation: none=0, study fixed effects=1, cluster-robust standard errors=2. The default study-level correlation option is none=0. This option can be changed in line 36 by inserting the corresponding number.
- Anderson-Rubin confidence interval (for weak instruments) for the meta-estimate: AR=0, no (default); AR=1, yes. This option is available for the unweighted MAIVE – PET, PEESE and PET-PEESE versions. It is not available for study fixed effects. Its use is recommendable if the first stage F-test statistic lies between 10 and 100 (see Keane and Neal, 2023, for further details). The default option can be changed in line 38 by inserting the corresponding number. Note that obtaining the AR confidence interval takes some time.

3. Output

The code returns:

1. A MAIVE point estimate and a standard error.
2. A Hausman-type test statistic and a 5% critical value. The test statistic consists of a weighted squared difference between the MAIVE point estimate and a standard point estimate. The latter is obtained from the same method as chosen for MAIVE but with inverse-variance weights and without instrumenting the standard errors.
3. When instrumenting the standard errors, the code also returns a heteroskedasticity-robust F test of the first-stage regression.
4. When choosing the AR option, the code also returns a Anderson-Rubin confidence interval for weak instruments.
5. The instrumented standard errors are saved as `SE_instrumented` and can be obtained as “*MAIVE\$SE_instrumented*”.

Figure 2 provides an example of the output in R.

Figure 2: Example of the output in R

The screenshot shows the RStudio interface. The top pane displays R code for the MAIVE function. The bottom pane shows the console output of the function.

```

1 # R code for MAIVE
2 #
3 # 1. Input as excel file:
4 #
5 #     estimates: bs
6 #     standard errors: sebs
7 #     number of observations: Ns
8 #     (optional: study_id)
9 #
10 # 2. Default option for MAIVE: MAIVE-PET-PEESE, unweighted, with instrumented SEs
11 #
12 # Other available options to the user:
13 #     method= 1 FAT-PET, 2 PEESE, 3 PET-PEESE, 4 EK
14 #     weighting = 0 no weights, 1 standard weights, 2 adjusted weights
15 #     instrumenting = 1 yes, 0 no
16 #     correlation at study level: 0 none, 1 fixed effect dummies, 2 clusters
17
30:11 (Top Level)

```

The console output shows the results of the MAIVE function:

```

> MAIVEResults
              object      value
1      MAIVE coefficient    0.193
2      MAIVE standard error  0.264
3      F-test of first step in IV 193.672
4 Hausman-type test (to be used with caution) 0.403
5      Critical Value of Chi2(1)  3.841
6      AR Confidence interval -0.189 0.901
>

```

4. Technical comments

- In the first-stage, we regress the variances on a constant and the inverse sample sizes.
- The Hausman-type test is weighted by the variance of the MAIVE estimator and is, consequently, a conservative test. It only compares the intercepts.
- If study fixed effects are included, the dummy variables are demeaned so that the intercept measures a grand mean.
- If the user does not provide a ‘study-id’ column, the program assumes that the study-level correlation option is *none*.
- The Anderson-Rubin confidence interval is obtained in the standard way (see Keane and Neal, 2023, for further details).

References

Keane, Michael and Neal, Timothy. 2023. “Instrument strength in IV estimation and inference: A guide to theory and practice”, *Journal of Econometrics*, 235, 2, 1625-1653. <https://doi.org/10.1016/j.jeconom.2022.12.009>.