Hedges g (one-sample) (es_hedges_g_os)

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Introduction

The *es_hedges_g_os* function calculates a Hedges g effect size, for one-sample situations.

This document contains the details on how to use the functions, and formulas used in them.

1 About the Function

1.1 Input parameters:

- **data**
  - Excel: a specific range with the numeric scores
  - Python: a pandas series with the numeric scores
  - R: a vector with the numeric scores

- *Optional parameters*
  - **mu**
    the hypothesized mean. If not specified the midrange will be used.
  - **appr**
    The approximation to use either:
    - "none" for exact method. Note that if df/2 > 171 the Xue approximation will be used.
    - "hedges" for the Hedges approximation
    - "durlak" for the Durlak approximation
    - "xue" for the Xue approximation
  - **qual**
    the rule-of-thumb method to use for the classification (see *th_cohen_d* for details)

1.2 Output

- **g**
  the effect size measure
- **classification**
  classification/qualification of the effect size
- **version**
  the version used in the calculation

Note for *Excel:*

the array function *es_hedges_g_os_arr* will require 2 rows and 3 columns.

1.3 Dependencies

- **Excel**
  - *th_cohen_d* from *thumb_cohen_d* for the qualification
  - Optional you can run the **es_hedges_g_os_addHelp** macro so that the function will be available with some help in the 'User Defined' category in the functions overview.
- **Python**
  The following libraries are needed:
  - pandas is needed for data entry and showing the results
  - *th_cohen_d* from *thumb_cohen_d* for the qualification
- **R**
  - *th_cohen_d* from *thumb_cohen_d* for the qualification

2 Examples

2.1 Excel

	A	B	C	D	E	F	G	H
1	Over_Grade							
2	20							
3	50		hyp. Mean.	70				
4	80							
5	15			appr				
6	40		out	exact	hedges	durlak	xue	
7	85		value	-0,57147	-0,571523	-0,540921	-0,571469	
8	30		qual	large	large	medium	large	
9	45							
10	70		D7 =>	=es_hedges_g_os($A$2:$A$21;$D$3;D$6;;$C7)				
11	60							
12	90		Hedges g	Classificat	comment			
13	25		-0,0243178	negligible	exact			
14	40							
15	70		C12:E13 =>	=es_hedges_g_os_arr(A2:A21)				
16	65							
17	70							
18	98							
19	40							
20	65							
21	60							
22								

2.2 Python

```
[1]: from eff_size_hedges_g_os import es_hedges_g_os
     import pandas as pd

     dataList = [20, 50, 80, 15, 40, 85, 30, 45, 70, 60, 90, 25, 40, 70, 65, 70, 98, 40,
     data = pd.Series(dataList)

     es_hedges_g_os(data)
```

[1]:

	Hedges g	Classification	Version
0	-0.024318	negligible	exact

```
[2]: es_hedges_g_os(data, mu=70)
```

[2]:

	Hedges g	Classification	Version
0	-0.571469	very large	exact

```
[3]: es_hedges_g_os(data, appr="hedges")
```

[3]:

	Hedges g	Classification	Version
0	-0.02432	negligible	Hedges approximation

```
[4]: es_hedges_g_os(data, appr="durlak")
```

[4]:

	Hedges g	Classification	Version
0	-0.023018	negligible	Durlak approximation

```
[5]: es_hedges_g_os(data, appr="xue")
```

[5]:

	Hedges g	Classification	Version
0	-0.024318	negligible	Xue approximation

2.3 R

```
> source("thumb_cohen_d.R")
> source("eff_size_hedges_g_os.R")
>
> data <- c(20, 50, 80, 15, 40, 85, 30, 45, 70, 60, 90, 25, 40, 70, 65, 70, 98, 40, 65, 60)
> es_hedges_g_os(data)
     Hedges g Classification Version
1 -0.02431784     negligible   exact
> es_hedges_g_os(data, mu=70)
    Hedges g Classification Version
1 -0.5714692          large   exact
> es_hedges_g_os(data, appr="hedges")
     Hedges g Classification              Version
1 -0.02432011     negligible Hedges approximation
> es_hedges_g_os(data, appr="durlak")
     Hedges g Classification              Version
1 -0.02301792     negligible Durlak approximation
> es_hedges_g_os(data, appr="xue")
     Hedges g Classification           Version
1 -0.02431784     negligible Xue approximation
```

3 Details of Calculations

3.1 Exact

$$g = d' \times \frac{\Gamma(m)}{\Gamma\left(m - \frac{1}{2}\right) \times \sqrt{m}}$$

With:

$$m = \frac{df}{2}$$

$$df = n - 1$$

Symbols:

- d' is Cohen's d for one-sample (see section **Error! Reference source not found.**)
- df is the degrees of freedom
- n is the sample size
- $\Gamma(\dots)$ the gamma function

3.2 Hedges approximation

$$g \approx d' \times \left(1 - \frac{3}{4 \times df - 1}\right)$$

With:

$$df = n - 1$$

Symbols:

- d' is Cohen's d for one-sample (see section **Error! Reference source not found.**)
- df is the degrees of freedom
- n is the sample size

3.3 Durlak approximation

$$g \approx d' \times \frac{n - 3}{n - 2.25} \times \sqrt{\frac{n - 2}{n}}$$

Symbols:

- d' is Cohen's d for one-sample (see section **Error! Reference source not found.**)
- n is the sample size

3.4 Xue approximation

$$g \approx d' \times \sqrt[12]{1 - \frac{9}{df} + \frac{69}{2 \times df^2} - \frac{72}{df^3} + \frac{687}{8 \times df^4} - \frac{441}{8 \times df^5} + \frac{247}{16 \times df^6}}$$

With:

$$df = n - 1$$

Symbols:

- d' is Cohen's d for one-sample (see section **Error! Reference source not found.**)
- df is the degrees of freedom

4 Sources

$$c(m) = \frac{\Gamma\left(\frac{m}{2}\right)}{\sqrt{\frac{m}{2}}\;\Gamma\left(\frac{m-1}{2}\right)} \quad . \qquad (6e)$$

(Hedges, 1981, p. 111)

Note that Hedges use m for the degrees of freedom.

packaged computer programs. The approximation is

$$c(m) \approx 1 - \frac{3}{4m-1} \quad .$$

(Hedges, 1981, p. 114)

(1) Calculating Hedges' g from means, standard deviations and ns

$$g = \frac{M_E - M_C}{SD \text{ pooled}} \times \left(\frac{N-3}{N-2.25}\right) \times \sqrt{\frac{N-2}{N}}$$

(Durlak, 2009, p. 927)

$$(2.14) \qquad J(m) \approx P_6(m) = \sqrt[12]{1 - \frac{9}{m} + \frac{69}{2m^2} - \frac{72}{m^3} + \frac{687}{8m^4} - \frac{441}{8m^5} + \frac{247}{16m^6}}$$

(Xue, 2020, p. 3)

References

Durlak, J. A. (2009). How to select, calculate, and interpret effect sizes. *Journal of Pediatric Psychology*, *34*(9), 917–928. https://doi.org/10.1093/jpepsy/jsp004

Hedges, L. V. (1981). Distribution Theory for Glass's Estimator of Effect Size and Related Estimators. *Journal of Educational Statistics*, *6*(2), 107–128. https://doi.org/10.2307/1164588

Xue, X. (2020). *Improved approximations of Hedges' g**. https://doi.org/10.48550/arXiv.2003.06675