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Who's afraid of the effect size?

Ciprian Turturean*

"Alexandru Ioan Cuza" University of Iasi,, Carol 1 Ave., no. 22, 700505, Iasi, Romania

Abstract

The *effect size* (no more than 35 years) is new topic discussion especially in psychological field. He is quantified by a class of descriptive statistical indicators which based on d Cohen's coefficient.
The effect size bring us an additional information to inferential decision to accept or to reject the Null Hypothesis, reason that we find an wide discussion under name Null Hypothesis Significance Testing (NHTS). Therefore the American Psychological Association (APA) recommended in chapter 1.01 Designing and Reporting Research; all published statistical reports also include effect size (APA 5th edition manual section (2002)).

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1. Introduction - What's the effect size?

Statistical tests comparing the central level between two statistical distributions give us the answer to the question: Are *there significant differences between the two different treatments?* but they fail to give us information on the magnitude of the difference. What is more, if we work with two different pair of samples, the estimated variances and central levels, most probably, will differ even if the samples volume and the populations of origin are the same. The new questions that arise are: *How big is the magnitude of differences between two different treatments?, How can we quantify the magnitude of differences between two different treatments so that we offer comparability from one test to the other?, Therefore, what is the effect size?*

* Corresponding author. Tel.: +4-0752-197-401.
E-mail address: ciprian.turturean@uaic.ro

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Effect Size (ES) is a name given to a family of indices that measure the magnitude of treatment effect. Unlike significance tests, these indices are independent of sample size. ES measures are common currency of meta-analysis studies that summarize the findings from a specific area of research. (Lee A. Becker, [1]).

or

Effect size is a quantitative reflection of the magnitude of some phenomenon that is used for the purpose of addressing a question of interest. (Kelly & Preacher [2]).

Definitions of effect size abound in literature but many of them cannot capture the complexity of effect size dimensions. Therefore the effect size formulas take many forms according to the nature of the analyzed phenomena.

In essence the effect size discussions started from the more detailed analysis of the t statistics for two independent samples from two populations with same variance:

$$t = \frac{\mu_1 - \mu_2}{s_{1-2}\sqrt{\frac{1}{n_1} + \frac{1}{n_2}}} \quad (1)$$

in which the start-up problem is the square root of sum of samples dimension (n_1 and n_2). If n_1 and n_2 is sufficiently large, the calculated t value will be, most probably, larger than theoretical t, which lead to rejecting the null hypothesis in most cases. Therefore it is necessary to calculate a descriptive value which doesn't depend on n_1 and n_2 values, but which reflects the magnitude of differences between two compared means.

The corresponding effect size for mean differences tested by the t statistic from the formulas (1) is:

$$ES = t\sqrt{\frac{n_1 + n_2}{n_1 n_2}} = \frac{\mu_1 - \mu_2}{s_{1-2}} \quad (2)$$

2. Effect size indicators

There is a wide diversity of indicators used to measure the effect size. Effect size (ES) indicators enable comparisons between the sizes of the effects.

The most common form of expression of effect size indicators is: correlation coefficients or standardized mean *differences*.

ES indicators can be classified:

1. by number of compared groups:

- the difference between two groups;
- the difference between more than two groups.

2. by the measure used to quantify the ES:

- as a standardized difference between two means;
- as the correlation between the independent variable classification and the individual scores on the dependent variable named "ES correlation" (Rosnow & Rosenthal [3]).

A. The most common ES *coefficients used in practice for two mean comparisons* are (t test):

1. Cohen's d original coefficient (Cohen [4])

$$d = \frac{\bar{x}_1 - \bar{x}_2}{\sigma_{1/2}} \quad (3)$$

where $\bar{x}_1$ and $\bar{x}_2$ are the means of two populations compared and is the standard deviation of one of them when the hypothesis of homoskedasticity is satisfied and the large sizes of the samples.

2. Cohen's d practical coefficient (Rosnow & Rosenthal [3])

$$d = \frac{\bar{x}_1 - \bar{x}_2}{\sigma_{pooled}} \quad (4)$$

Initially (Cohen [4]) the σ_{pooled} was calculated as a mean of two variances corresponding to the two compared groups when the hypothesis of homoskedasticity is satisfied and for large sizes of the samples: