

# Package ‘equivUMP’

October 13, 2022

**Type** Package

**Title** Uniformly Most Powerful Invariant Tests of Equivalence

**Version** 0.1.1

**Description** Implementation of uniformly most powerful invariant equivalence tests for one- and two-sample problems (paired and unpaired) as described in Wellek (2010, ISBN:978-1-4398-0818-4). Also one-sided alternatives (non-inferiority and non-superiority tests) are supported. Basically a variant of a t-test with (relaxed) null and alternative hypotheses exchanged.

**License** GPL (>= 2)

**URL** <https://github.com/thmild/equivUMP>

**BugReports** <https://github.com/thmild/equivUMP/issues>

**Encoding** UTF-8

**LazyData** true

**RoxygenNote** 6.1.1

**NeedsCompilation** no

**Author** Thoralf Mildenerger [aut, cre]

**Maintainer** Thoralf Mildenerger <mild@zhaw.ch>

**Repository** CRAN

**Date/Publication** 2019-04-13 08:22:52 UTC

## R topics documented:

equiv.test . . . . .	2
<b>Index</b>	<b>5</b>

---

equiv.test	<i>Equivalence and non-inferiority tests for one- and two-sample problems</i>
------------	---

---

### Description

Implementation of uniformly most powerful invariant equivalence tests for one- and two-sample problems (paired and unpaired). Also one-sided alternatives (non-inferiority and non-superiority tests) are supported. Basically a variant of a t-test with (relaxed) null and alternative hypotheses exchanged.

### Usage

```
equiv.test(x, ...)

## Default S3 method:
equiv.test(x, y = NULL, alternative = c("two.sided",
  "less", "greater"), eps = 1, mu = 0, paired = FALSE, ...)

## S3 method for class 'formula'
equiv.test(formula, data, subset, na.action, ...)
```

### Arguments

x	a (non-empty) numeric vector of data values.
...	further arguments to be passed to or from methods.
y	an optional (non-empty) numeric vector of data values.
alternative	a character string specifying the alternative hypothesis, must be one of "two.sided" (default), "greater" or "less". You can specify just the initial letter.
eps	a single strictly positive number giving the equivalence limits.
mu	a number indicating the true value of the mean (or difference in means if you are performing a two sample test).
paired	a logical indicating whether you want a paired equivalence test in the two-sample case.
formula	a formula of the form lhs ~ rhs where lhs is a numeric variable giving the data values and rhs a factor with two levels giving the corresponding groups.
data	an optional matrix or data frame containing the variables in the formula formula. By default the variables are taken from environment(formula).
subset	an optional vector specifying a subset of observations to be used.
na.action	a function which indicates what should happen when the data contain NAs. Defaults to getOption("na.action").

## Details

`equiv.test` is modelled after (and borrows code from) R's `t.test()` and is intended to work as similarly as possible.

This functions implements uniformly most powerful invariant equivalence tests for one-sample and (paired or unpaired) two-sample problems. Also supported are one-sided versions (so-called non-inferiority or non-superiority tests).

All tests are on standardized (differences of) means  $\theta$ :

$$\theta = (\mu_x - \mu) / \sigma$$

for the one-sample case,

$$\theta = (\mu_d - \mu) / \sigma_d$$

for the paired two-sample case and

$$\theta = (\mu_x - \mu_y - \mu) / \sigma$$

for the unpaired test, where  $\sigma$  is the standard deviation of  $x$  and  $y$  and  $\sigma_d$  is the standard deviation of the differences.  $\mu$  is a shift parameter that can be used to compare against a known value in the one-sample case.  $\mu$  should usually be zero for two-sample problems.

The null and alternative hypotheses in equivalence tests (`alternative = "two.sided"`) are

$$H_0 : \theta \leq -\epsilon \quad \text{or} \quad \theta \geq \epsilon$$

vs

$$H_1 : -\epsilon < \theta < \epsilon$$

Currently, only symmetric equivalence intervals  $(-\epsilon, \epsilon)$  are supported.

In the non-inferiority-case (`alternative = "greater"`) we test

$$H_0 : \theta \leq -\epsilon$$

vs

$$H_1 : \theta > -\epsilon$$

In the non-superiority-case (`alternative = "less"`) we test

$$H_0 : \theta \geq \epsilon$$

vs

$$H_1 : \theta < \epsilon$$

If `paired` is TRUE then both `x` and `y` must be specified and they must be the same length. Missing values are silently removed (in pairs if `paired` is TRUE).

The formula interface is only applicable for the two-sample tests.

**Value**

A list with class `htest` containing the following components:

<code>statistic</code>	the value of the t-statistic.
<code>parameter</code>	the degrees of freedom for the t-statistic.
<code>p.value</code>	the p-value for the test.
<code>estimate</code>	the plug-in estimate of the standardized mean (or mean difference), i.e. the empirical mean (or difference of empirical means) divided by the empirical standard deviation. Note that this estimate is not unbiased.
<code>null.value</code>	non-equivalence limits, i.e. boundaries of null hypothesis
<code>alternative</code>	a character string describing the alternative hypothesis.
<code>method</code>	a character string indicating what type of equivalence test was performed.
<code>data.name</code>	a character string giving the name(s) of the data.

**Methods (by class)**

- `default`: Default S3 method:
- `formula`: S3 method for class 'formula'

**References**

Wellek, S. (2010). Testing Statistical Hypotheses of Equivalence and Noninferiority. Second edition. Boca Raton: Chapman & Hall. (especially Chapters 5.3 and 6.1).

**Examples**

```
# compare two feed from chickwts dataset
data("chickwts")
chickwts2 <- chickwts[chickwts$feed %in% c("linseed", "soybean"),]
chickwts2$feed <- droplevels(chickwts2$feed)

# similar but cannot be shown to be equivalent up to 0.5 sigma at 0.05 level^
plot(weight ~ feed, data = chickwts2)
equiv.test(weight ~ feed, data = chickwts2, eps = 0.5)
```

# Index

`equiv.test`, 2