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Description

Calculate the fuzzy P-value, the fuzzy decision, or the fuzzy confidence interval associated with the
Mann-Whitney-Wilcoxon rank sum test.

Usage

fuzzy.ranksum.test(x, y, alternative = c("two.sided", "less", "greater"),
mu = 0, tol = sqrt(.Machine$double.eps), alpha)
fuzzy.ranksum.ci(x, y, alternative = c("two.sided", "less", "greater"),
tol = sqrt(.Machine$double.eps), conf.level = 0.95)
Arguments

- **x**: numeric vector of data values.
- **y**: 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.
- **mu**: a number specifying the value of the median of the data distribution hypothesized under the null hypothesis.
- **tol**: data values within tol of mu are considered equal to mu.
- **alpha**: if missing, calculate the fuzzy P-value. If provided, must be between zero and one, then calculate the fuzzy decision.
- **conf.level**: confidence level.

Details

The fuzzy P-value is a random variable taking values in the interval \((0, 1)\). Its cumulative distribution function (CDF) is continuous and piecewise linear. Hence its probability density function (PDF) is piecewise constant (a step function). If \(P\) is the fuzzy P-value, considered as a random variable, then the randomized test that rejects the null hypothesis at significance level \(\alpha\) when \(P < \alpha\) is an exact (randomized) test.

The fuzzy confidence interval is a fuzzy set, whose “membership function” is a function on the parameter space taking values in the interval \([0, 1]\). For rank tests, it is piecewise constant (a step function). In the regular case, it is one on a narrow interval and some number between zero and one on the part of some wider interval not contained in the narrower interval, zero outside the wider interval, and the values at jumps are the average of left and right limits. In this case, the fuzzy interval can be easily interpreted as a mixture of two confidence intervals (the narrow and the wide). When no ties are possible, the values at the jumps do not matter. Otherwise, they do. With ties, any or all of the intervals can be degenerate, and the values at the jumps are not related to left and right limits. If \(I(\mu)\) is the membership function of the fuzzy confidence interval, then the randomized test that rejects the null hypothesis that \(\mu\) is the true parameter value with probability \(1 - I(\mu)\) is an exact (randomized) test.

Value

A list with class "fuzzyranktest" or class "fuzzyrankci" containing some of the following components:

- **knots**: the vector of points at which the CDF of the fuzzy P-value, which is continuous and piecewise linear, has discontinuous derivative or the vector of points at which the membership function of the fuzzy confidence is discontinuous and also -Inf or Inf if the fuzzy confidence interval is unbounded.
- **values**: the values of the CDF of the fuzzy P-value at the knots.
- **knot.values**: the values of the membership function of the fuzzy confidence interval at the knots.
- **interval.values**: the values of the membership function of the fuzzy confidence interval between the knots.
- **reject.prob**: if alpha is specified, the probability the randomized test rejects the null hypothesis, which is the same as the probability the fuzzy P-value is less than alpha.
**fuzzy.sign.test**

alpha the argument alpha.
null.value the argument mu.
alternative a character string describing the alternative hypothesis.
method the type of test applied.
data.name a character string giving the names of the data.
conf.level the argument conf.level.
tol the argument tol.

**References**

Charles J. Geyer (submitted).
Fuzzy P-values and Ties in Nonparametric Tests.

Fuzzy and Randomized Confidence Intervals and P-values.
To appear in *Statistical Science* (with discussion).

**See Also**

plot.fuzzyrankci, plot.fuzzyranktest, print.fuzzyrankci, print.fuzzyranktest.

**Examples**

```r
#### make up data ####
x <- c(1, 2, 3, 4, 4, 4, 5, 6, 7)
y <- c(4, 5, 7, 7, 8, 9, 10, 11)
fuzzy.ranksum.test(x, y)
plot(fuzzy.ranksum.test(x, y))
fuzzy.ranksum.ci(x, y)
plot(fuzzy.ranksum.ci(x, y))
```

---

**Usage**

```r
fuzzy.sign.test(x, alternative = c("two.sided", "less", "greater"),
mu = 0, tol = sqrt(.Machine$double.eps), alpha)
fuzzy.sign.ci(x, alternative = c("two.sided", "less", "greater"),
tol = sqrt(.Machine$double.eps), conf.level = 0.95)
```
Arguments

- **x**: 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.
- **mu**: a number specifying the value of the median of the data distribution hypothesized under the null hypothesis.
- **tol**: data values within tol of mu are considered equal to mu.
- **alpha**: if missing, calculate the fuzzy P-value. If provided, must be between zero and one, then calculate the fuzzy decision.
- **conf.level**: confidence level.

Details

The fuzzy P-value is a random variable taking values in the interval (0, 1). Its cumulative distribution function (CDF) is continuous and piecewise linear. Hence its probability density function (PDF) is piecewise constant (a step function). If \( P \) is the fuzzy P-value, considered as a random variable, then the randomized test that rejects the null hypothesis at significance level \( \alpha \) when \( P < \alpha \) is an exact (randomized) test.

The fuzzy confidence interval is a fuzzy set, whose "membership function" is a function on the parameter space taking values in the interval \([0, 1]\). For rank tests, it is piecewise constant (a step function). In the regular case, it is one on a narrow interval and some number between zero and one on the part of some wider interval not contained in the narrower interval, zero outside the wider interval, and the values at jumps are the average of left and right limits. In this case, the fuzzy interval can be easily interpreted as a mixture of two confidence intervals (the narrow and the wide). When no ties are possible, the values at the jumps do not matter. Otherwise, they do. With ties, any or all of the intervals can be degenerate, and the values at the jumps are not related to left and right limits. If \( I(\mu) \) is the membership function of the fuzzy confidence interval, then the randomized test that rejects the null hypothesis that \( \mu \) is the true parameter value with probability \( 1 - I(\mu) \) is an exact (randomized) test.

Value

A list with class "fuzzy.ranktest" or class "fuzzy.rankci" containing some of the following components:

- **knots**: the vector of points at which the CDF of the fuzzy P-value, which is continuous and piecewise linear, has discontinuous derivative or the vector of points at which the membership function of the fuzzy confidence is discontinuous and also \(-\infty\) or \(\infty\) if the fuzzy confidence interval is unbounded.
- **values**: the values of the CDF of the fuzzy P-value at the knots.
- **knot.values**: the values of the membership function of the fuzzy confidence interval at the knots.
- **interval.values**: the values of the membership function of the fuzzy confidence interval between the knots.
- **reject.prob**: if alpha is specified, the probability the randomized test rejects the null hypothesis, which is the same as the probability the fuzzy P-value is less than alpha.
- **alpha**: the argument alpha.
**fuzzy.signrank.test**

*Fuzzy P-value, Decision, or Confidence Interval for the Rank Sum Test*

**Description**

Calculate the fuzzy P-value, the fuzzy decision, or the fuzzy confidence interval associated with the Mann-Whitney-Wilcoxon rank sum test.

**Usage**

```r
fuzzy.signrank.test(x, alternative = c("two.sided", "less", "greater"),
                    mu = 0, tol = sqrt(.Machine$double.eps), alpha)
```

```r
fuzzy.signrank.ci(x, alternative = c("two.sided", "less", "greater"),
                   tol = sqrt(.Machine$double.eps), conf.level = 0.95)
```

**statistic**  the value of the test statistic with a name describing it.

**null.value**  the argument `mu`.

**alternative**  a character string describing the alternative hypothesis.

**method**  the type of test applied.

**data.name**  a character string giving the names of the data.

**conf.level**  the argument `conf.level`.

**tol**  the argument `tol`.

**References**

Charles J. Geyer (submitted).
*Fuzzy P-values and Ties in Nonparametric Tests.*

*Fuzzy and Randomized Confidence Intervals and P-values.*
To appear in *Statistical Science* (with discussion).

**See Also**

`plot.fuzzyrankci`, `plot.fuzzyranktest`, `print.fuzzyrankci`, `print.fuzzyranktest`.

**Examples**

```r
#### make up data ####
x <- c(-1.2, -0.7, 0.2, 0.2, 0.2, 0.3, 0.4, 0.9, 0.9, 1.0, 1.0,
       1.1, 1.5, 1.7, 1.9, 3.5, 5.1)
fuzzy.sign.test(x)
plot(fuzzy.sign.test(x))
fuzzy.sign.ci(x)
plot(fuzzy.sign.ci(x))
```

```r
fuzzy.signrank.test(x)
```

```r
Fuzzy P-value, Decision, or Confidence Interval for the Rank Sum Test
```
Arguments

- **x**: 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.
- **mu**: a number specifying the value of the median of the data distribution hypothesized under the null hypothesis.
- **tol**: data values within tol of mu are considered equal to mu.
- **alpha**: if missing, calculate the fuzzy P-value. If provided, must be between zero and one, then calculate the fuzzy decision.
- **conf.level**: confidence level.

Details

The fuzzy P-value is a random variable taking values in the interval (0, 1). Its cumulative distribution function (CDF) is continuous and piecewise linear. Hence its probability density function (PDF) is piecewise constant (a step function). If \( P \) is the fuzzy P-value, considered as a random variable, then the randomized test that rejects the null hypothesis at significance level \( \alpha \) when \( P < \alpha \) is an exact (randomized) test.

The fuzzy confidence interval is a fuzzy set, whose “membership function” is a function on the parameter space taking values in the interval \([0, 1]\). For rank tests, it is piecewise constant (a step function). In the regular case, it is one on a narrow interval and some number between zero and one on the part of some wider interval not contained in the narrower interval, zero outside the wider interval, and the values at jumps are the average of left and right limits. In this case, the fuzzy interval can be easily interpreted as a mixture of two confidence intervals (the narrow and the wide). When no ties are possible, the values at the jumps do not matter. Otherwise, they do. With ties, any or all of the intervals can be degenerate, and the values at the jumps are not related to left and right limits. If \( I(\mu) \) is the membership function of the fuzzy confidence interval, then the randomized test that rejects the null hypothesis that \( \mu \) is the true parameter value with probability \( 1 - I(\mu) \) is an exact (randomized) test.

Value

A list with class "fuzzyranktest" or class "fuzzyrankci" containing some of the following components:

- **knots**: the vector of points at which the CDF of the fuzzy P-value, which is continuous and piecewise linear, has discontinuous derivative or the vector of points at which the membership function of the fuzzy confidence is discontinuous and also \(-\infty\) or \(+\infty\) if the fuzzy confidence interval is unbounded.
- **values**: the values of the CDF of the fuzzy P-value at the knots.
- **knot.values**: the values of the membership function of the fuzzy confidence interval at the knots.
- **interval.values**: the values of the membership function of the fuzzy confidence interval between the knots.
- **reject.prob**: if alpha is specified, the probability the randomized test rejects the null hypothesis, which is the same as the probability the fuzzy P-value is less than alpha.
- **alpha**: the argument alpha.
null.value  the argument mu.
alternative  a character string describing the alternative hypothesis.
method      the type of test applied.
data.name    a character string giving the names of the data.
conf.level   the argument conf.level.
tol          the argument tol.

References
Charles J. Geyer (submitted).
Fuzzy P-values and Ties in Nonparametric Tests.
Fuzzy and Randomized Confidence Intervals and P-values.
To appear in Statistical Science (with discussion).

See Also
plot.fuzzyrankci, plot.fuzzyranktest, print.fuzzyrankci, print.fuzzyranktest.

Examples
#### make up data ####
x <- c(-3, -2, -2, 0, 0, 0, 0, 1, 2, 3, 4, 4, 4, 5, 6, 7)
fuzzy.signrank.test(x, alt = "less")
plot(fuzzy.signrank.test(x, alt = "less"))
fuzzy.signrank.ci(x)
plot(fuzzy.signrank.ci(x))

Description
Plot or Print Fuzzy Rank Objects.

Usage
plot.fuzzyrankci(x, y, add = FALSE, verticals = FALSE,
col.hor = par("col"), col.vert = par("col"), lty.vert = 2,
pch.vert = 19, full.ylim = TRUE, extra.xlim = 0.2, main, ...)
plot.fuzzyranktest(x, y, type = c("pdf", "cdf"), add = FALSE,
col.hor = par("col"), col.vert = par("col"), lty.vert = 2,
extra.xlim = 0.2, main, ...)
print.fuzzyrankci(x, digits = 4, ...)
print.fuzzyranktest(x, digits = 4, ...)
Arguments

- **x**: object of class "fuzzyrankci" or "fuzzyranktest".
- **y**: not used (required because plot is generic).
- **type**: if "pdf" plot the probability density function of the fuzzy P-value, if "cdf" plot the cumulative distribution function. You can specify just the initial letter.
- **add**: if TRUE add to existing plot, otherwise make new plot.
- **verticaks**: if TRUE, put in vertical lines at jumps.
- **col.hor**: color for horizontal lines of step functions.
- **col.vert**: color for vertical lines of step functions (if requested).
- **lty.vert**: line type for vertical lines of step functions (if requested).
- **pch.vert**: point type (see argument pch of points) for values at jumps of step functions.
- **full.ylim**: use ylim = c(0, 1) in the plot.
- **extra.xlim**: make flat parts of the graph to either side of the interesting parts at least extra.xlim times the range of the interesting parts, where "interesting parts" means the part where the PDF of the fuzzy P-value or the membership function of the fuzzy confidence interval is nonzero.
- **main**: main title for plot. Usually missing, in which case standard titles are used.
- **...**: extra arguments passed internally to plot functions.
- **digits**: supplied to format and print internally.

See Also

`plot, print, fuzzy.sign.ci, fuzzy.sign.test.`
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