Package ‘fixedpointproperty’

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Type Package
Title Determine and Test the Fixed-Point Property in Binary Mixture Data
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Description Determine and test the fixed-point property in binary mixture data. This package was originally developed in the context of detecting mixture of cognitive processing strategies, based on observed response time distributions. The method is explain in more detail by Van Maanen, De Jong, Van Rijn (2014) <doi:10.1371/journal.pone.0106113> and Van Maanen, Couto, Lebreton, (2016) <doi:10.1371/journal.pone.0167377>.

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fpAnova

Function to perform ANOVA on fp objects

Description
This function computes Bayes Factors and p-values for within-subjects ANOVA designs, encoded as fp objects.

Usage
fpAnova(object, stat = "BF", na.rm = TRUE, check = TRUE)

Arguments
- object: a list of objects from class fpp.
- stat: Either "BF" (default), "p", or "both", specifying what statistic to report.
- na.rm: Are NAs removed?
- check: Should the data be checked for suitability? A warning will be provided if a check is failed.

Details
The function expects the output of fpGet, but in a list.

Value
A list containing the results of either the Bayesian or frequentist analysis, or both:

- BF: The output of anovaBF
- p: The output of summary.aov

Warning
If check=TRUE, then warnings will be provided if the data are not suitable for correct inferences.

Author(s)
Leendert van Maanen (l.vanmaanen@uu.nl)

References
fpConditionCheck

See Also

fpGet, anovaBF, fpConditionCheck, summary.aov.

Examples

```r
## generate data
p <- c(.1,.5,.9)
rt <- sapply(1:3, function(i) {rnormMix(10000, c(1,2), c(1,1), p[i])})
dat <- data.frame(rt=c(rt), cond=rep(1:3, each=10000), pp=rep(1:50, each=200, times=3))

## compute the list of fpp objects
res <- tapply(1:nrow(dat), dat$pp, function(X) {fpGet(dat[X,], 1000, bw=.75)})

## call fpAnova, with stat="both" to do both a Bayesian and a frequentist test
fpAnova(res, stat="both")
```

Description

This function checks whether two conditions are met before performing fpANOVA.

Usage

fpConditionCheck(object)

Arguments

- `object`: a list of objects from class fpp.

Details

Finding support for the fixed-point property will be mute if there is no significant difference between experimental conditions. Whether all conditions differ can be tested using fpConditionCheck1, which performs pairwise t-tests. A warning is provided if at least one pair of conditions does not significantly differ (default settings of pairwise.t.test are used).

Finding support for the fixed-point property is difficult if the bandwidth of the density estimation is chosen too small. In that case, multiple crossing points of pairs of densities will preclude a precise estimate of the fixed point. fpConditionCheck2 tests the number of crossing points for each pair of conditions, and provides a warning if more crossing points are detected.

Value

No return value, called for warnings generated by fpConditionCheck1 and fpConditionCheck2

Author(s)

Leendert van Maanen (l.vanmaanen@uu.nl)
References


See Also

fpAnova, pairwise.t.test

Examples

N <- 200  # nr of observations per condition
M <- 50  # nr of participants
p <- seq(0.1, 0.9, 0.4)  # mixture proportions
means <- c(0.3, 0.3)  # means of base distributions are equal, yielding a warning if check=TRUE
sigma <- 5  # scale of base distributions
bw <- 0.01
# kernel bandwidth of the density estimation. Too small values yield a warning if check=TRUE

### generate data
rt <- NULL
for (i in 1:length(p)) {
  rt <- c(rt, ifelse(sample(0:1, N * M, replace = TRUE, prob = c(p[i], 1 - p[i])),
                   rnorm(N * M, means[1], sigma), rnorm(N * M, means[2], sigma)))
}
rt <- rt + rep(rnorm(M, sd = 0.1), times = N)  # normally distributed pp random effect
dat <- data.frame(rt = rt, cond = rep(1:length(p), each = N * M), pp = rep(1:M, each = N))

### compute crossing points
res <- tapply(1:nrow(dat), dat$pp, function(X) {
  fpGet(dat[X, ], 1000, bw = bw)
})

### test fixed point
fpAnova(res, stat = "both", check=TRUE)  # this provides both warnings

fpDensDiff

Function to compute the crossing point of two kernel-based distribution functions

Description

This function takes a list of fpp objects, and computes at which point the distributions cross each other.
Usage

fpDensDiff(object)

Arguments

object a list of fpp objects

Value

An m * n-array containing the crossing points of the pairs of distributions, with n the length of the list of fpp objects, and m the number of pairs of distributions.

Author(s)

Leendert van Maanen (l.vanmaanen@uu.nl)

References


See Also

fpGet, fpAnova

Examples

## generate data
p <- c(.1,.5,.9)
rt <- sapply(1:3, function(i) {rnormMix(10000, c(1,2), c(1,1), p[i])})
dat <- data.frame(rt=c(rt), cond=rep(1:3, each=10000), pp=rep(1:50, each=200, times=3))

## compute the list of fpp objects
res <- tapply(1:nrow(dat), dat$pp, function(X) {fpGet(dat[X,], 1000, bw=.75)})

crosses=fpDensDiff(res)
boxplot(t(crosses), frame.plot=FALSE, xlab="Crossing point", ylab="Condition pair", names=c("1-2","2-3","1-3"), horizontal=TRUE)
Description

This function computes standard kernel-based density functions for a response time data set with three or more conditions. In addition, it computes the pairwise differences for each pair of density functions.

Usage

fpGet(dat, n = 512, bw = "nrd0")

Arguments

dat  n*2 dataframe or matrix with in col 1: RT (the values for which to compute the density); col 2: condition (an index)
n  the number of equally spaced points at which the density is to be estimated. See density for details.
bw  the smoothing bandwidth to be used. See density for details.

Value

an object of class fpp, with the following components.

dens  list of objects from class density
diff  dataframe of the density differences
dat  dataframe with the input data

Author(s)

Leendert van Maanen (l.vanmaanen@uu.nl)

References


See Also
density.
### Examples

#### one data set or participant

```r
## generate data
p <- c(.1,.5,.9)
rt <- sapply(1:3, function(i) {rnormMix(1000, c(1,2), c(1,1), p[i])})
dat <- data.frame(rt=c(rt), cond=rep(1:3, each=1000))

## compute one fp object
fpobject <- fpGet(dat, 1000, bw=.75)
```

#### multiple participants

```r
## generate data
p <- c(.1,.5,.9)
rt <- sapply(1:3, function(i) {rnormMix(10000, c(1,2), c(1,1), p[i])})
dat <- data.frame(rt=c(rt), cond=rep(1:3, each=10000), pp=rep(1:50, each=200, times=3))

## compute the list of fpp objects
res <- tapply(1:nrow(dat), dat$pp, function(X) {fpGet(dat[X,], 1000, bw=.75)})();
```

---

**fpp-class**

**Class** "fpp"

- **Description**
  - Objects of the fpp class are used by methods and functions of the fp package, to visualize and compute the fixed-point property in response time data.

- **Objects from the Class**
  - Objects can be created by calls of the form `new("fpp", ...)`.

- **Slots**
  - `dens`: Object of class "array". This is an array of objects of class "density".
  - `diff`: Object of class "data.frame". This is a dataframe with the paired differences between densities.
  - `dat`: Object of class "data.frame". This is a dataframe with the input data.

- **Methods**
  - `plot` signature(x = "fpp"): ...

- **Author(s)**
  - Leendert van Maanen (l.vanmaanen@uu.nl)
References


Examples

showClass("fpp")

---

**normMix**

*Gaussian binary mixture distribution*

Description

Density, distribution, function, quantile function, and random generation for the mixture of two Gaussian distributions with mixture proportion \( p \) and \( 1-p \).

Usage

```r
dnormMix(x, mean=c(0,1), sd=c(1,1), p=1)
pnormMix(x, mean=c(0,1), sd=c(1,1), p=1)
qnormMix(x, mean=c(0,1), sd=c(1,1), p=1)
rnormMix(n, mean=c(0,1), sd=c(1,1), p=1)
```

Arguments

- **x**: vector of quantiles or probabilities.
- **n**: number of observations.
- **mean**: vector of two means.
- **sd**: vector of standard deviations.
- **p**: mixture proportion of the first distribution (the second has proportion \(1-p\)).

Value

- `dnormMix` gives the density, `pnormMix` gives the distribution function, `qnormMix` gives the quantile function, and `rnormMix` generates random deviates.

Author(s)

Leendert van Maanen (l.vanmaanen@uu.nl)
plot.fpp

Function to plot the distributions and differences of multiple binary mixture distributions.

Description

This function plots kernel-based densities as well as density differences for three or more data sets (fpp objects).

Usage

## S3 method for class 'fpp'
plot(x, ylab = c("Density", "Density difference"), xlim = NULL, ...)

Arguments

- x: an fpp object
- ylab: y-axis labels of the plots
- xlim: the x limits (x1, x2) of the plots
- ...: additional arguments to pass to both plot.density and matplot

Details

Generates two plots, one showing the estimated densities (based on plot.density) and one showing the density differences (based on matplot)
Value

No return value, called for side effects

Author(s)

Leendert van Maanen (l.vanmaanen@uu.nl)

References


See Also

fpGet, fpDensDiff, plot.density, matplot

Examples

```r
## generate data
p <- c(0.1, 0.5, 0.9)
rt <- sapply(1:3, function(i) {rnormMix(1000, c(1,2), c(1,1), p[i])})
dat <- data.frame(rt=c(rt), cond=rep(1:3, each=1000))

## compute fpp object
fpobject <- fpGet(dat, 1000, bw=.75)

## plot it
op <- par(mfrow=c(1,2))
plot(fpobject)
par(op)
```

plot.fpp
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