

# Package ‘cin’

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**Type** Package

**Title** Causal Inference for Neuroscience

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**Description** Many experiments in neuroscience involve randomized and fast stimulation while the continuous outcome measures respond at much slower time scale, for example event-related fMRI. This package provide valid statistical tools with causal interpretation under these challenging settings, without imposing model assumptions.

**License** GPL-2

**Repository** CRAN

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**NeedsCompilation** no

## R topics documented:

cin . . . . .	1
cin-internal . . . . .	3

<b>Index</b>	<b>5</b>
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cin	<i>inference under interference</i>
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## Description

Test for treatment effects under interference for fMRI time series

## Usage

```
cin(X, k=5, type=c("sum", "correlation"), weight=NULL, TR=NULL, interp=FALSE)
```

**Arguments**

X	Input list of blocks (see reference), where each block could be one subject in one scan session. Each atom in this list is also a list of 3 vectors in the order: fMRI response time series, control stimulus events and treatment stimulus events (both in scans). An example of such input with one block could be <code>list(list(fmri=fmri, stmc=stmc, stmt=stmt))</code> where <code>fmri</code> , <code>stmc</code> , and <code>stmt</code> are all R numerical vectors.
k	k-1 controls and 1 treatment are compared. Default 5.
type	Method to summarize the response times series for each event, weighted summation or correlation with weight. Default sum.
weight	Weight used to summarize the time series points after each control or treatment event.
TR	Repetition Time used to generate weight from Canonical HRF (see reference) if <code>weight</code> is not specified.
interp	Whether interpolation of the fMRI time series will take place to produce observations at those event times. If <code>FALSE</code> , the event times will be rounded to nearest scans. Default <code>FALSE</code> .

**Details**

Performs causal inference test fMRI time series. The test is based on placement statistics (Orban and Wolfe, 1982). The test does not require model assumptions, and can provide valid inference on treatment effects even if there are interference between randomized stimuli.

Current implementation simply consolidates the test statistics from each subjects and each session. More complicated ways of aggregating these effects will be implemented in the future release.

**Value**

An object with S3 class "cin". You can also use it as a regular R list with the following fields:

Score	Actual test score. The test statistics is Dev.
Exp	Expected test score.
Var	Expected variance of test score.
Dev	Deviance or z-score.
p.value	One-side p-value for Dev.

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## References

Orban, J., and Wolfe, D. (1982). *A class of distribution-free two-sample tests based on placements*. Journal of the American Statistical Association 77: 666-672.

Luo, X., Small, S., Li, C.R., and Rosenbaum, P. (2012). *Inference with interference between units in an fMRI experiment of motor inhibition*. Journal of the American Statistical Association. To appear.

## Examples

```
## simulation from the null
fmri.ts <- arima.sim(list(order = c(1,1,0), ar = 0.7), n = 1000)
events <- sample(1000, 400)
stimt <- sample(events, 100)
stimc <- setdiff(events, stimt)
cin(list(list(fmri=fmri.ts, stimc=stimc, stimt=stimt)), TR=2)
```

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cin-internal

*internal cin functions*

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## Description

Internal cin functions

## Usage

```
gammaHRF(TR, paras=NULL, len.seconds=32, onset.seconds=0)
intertest(x,y,k=5)
truncSum(stim, y, hrf, isinterp=F, iscor=F)
```

## Arguments

TR	Repetition time.
paras	Parameters to specify the canonical HRF function, as in the Statistical Parametric Mapping package.
len.seconds	Total length of the HRF in seconds.
onset.seconds	Onset time of the first weight.
x	Control response values.
y	Treatment response values.
k	k-1 control values are compared with 1 treatment.
stim	Stimulus event times.
hrf	Hemodynamic response function weights.
isinterp	Whether to interpolate response values for non-integer event times (in scans).
iscor	Whether to summarize using correlation.

**Details**

There are not intended for use by users.

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# Index

\*Topic **nonparametric**

cin, 1

cin-internal, 3

\*Topic **ts**

cin, 1

cin-internal, 3

cin, 1

cin-internal, 3

gammaHRF (cin-internal), 3

intertest (cin-internal), 3

truncSum (cin-internal), 3