Package ‘rkt’

February 15, 2013

Type Package

Title Mann-Kendall test, Seasonal and Regional Kendall Tests

Version 1.1

Date 2012-11-05

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Description Contains function rkt which computes the Mann-Kendall test (MK) and the Seasonal and the Regional Kendall Tests for trend (SKT and RKT) and Theil-Sen’s slope estimator.

License GPL-2

Repository CRAN

Date/Publication 2012-11-28 15:35:52

NeedsCompilation no

R topics documented:

  rkt-package ......................................................... 2
  pie1 ............................................................ 3
  pie1w .......................................................... 4
  print.rkt ...................................................... 5
  rkt ............................................................. 6
  sign1 .......................................................... 8

Index 10
rkt-package

Mann-Kendall test, Seasonal and Regional Kendall Tests

Description

Contains function rkt which computes the Mann-Kendall test (MK) and the Seasonal and Regional Kendall Tests for trend (SKT and RKT) and Theil-Sen’s slope estimator.

Details

<table>
<thead>
<tr>
<th>Package</th>
<th>rkt</th>
</tr>
</thead>
<tbody>
<tr>
<td>Type</td>
<td>Package</td>
</tr>
<tr>
<td>Version</td>
<td>1.1</td>
</tr>
<tr>
<td>Date</td>
<td>2012-11-05</td>
</tr>
<tr>
<td>License</td>
<td>GPL-2</td>
</tr>
</tbody>
</table>

This function computes the Mann-Kendall test (MK) and the Seasonal and the Regional Kendall Tests for trend (SKT and RKT) and Sen’s slope estimator.

MK, SKT and RKT are tests for monotonic trend in time series based on the Kendall rank correlation.

SKT and RKT are intrablock tests in which test statistics are computed for each season or month (SKT) or for each site (RKT) and combined in an overall test.

In RKT, seasonality can be accounted for by using a blocking variable combining both sites and seasons, such as (site * 12 + month).

When a covariable is defined, this function also computes partial RKT and SKT.

To allow for non-regular sampling dates, input data should be vectors, not time series.

Author(s)

Maintainer: Aldo Marchetto <a.marchetto@ise.cnr.it>

References


Helsel D.R., Frans L.M. 2006 The regional Kendall test for trend: Environmental Science and Technology 40, 4066–4073


Examples

```r
# monthly data
#
data(pie1)
ex<-rkt(pie1$Year,pie1$SO4,pie1$Month,pie1$mm,TRUE)
print(ex)
#
# weekly data, no intrablock correction
#
data(pie1w)
ex<-rkt(pie1w$Date,pie1w$SO4)
print(ex)
```

---

**pie1**

*Example data for rkt function*

**Description**

Bulk open field deposition collected in Val Sessera (Italy) in 1998-2010, volume weighted monthly averages.

**Usage**

data(pie1)

**Format**

A data frame with 156 observations on the following 5 variables.

- **Year** sampling year
- **Month** sampling month
- **mm** amount of precipitation (mm)
- **SO4** sulphate concentration (mg/L)
- **NO3** nitrate concentration (mg N/L)
Details

SO4 shows a highly significant decreasing trend, NO3 shows a moderately significant decreasing trend and mm no significant trend

Source


Examples

data(pie1)

rkt(pie1$Year,pie1$SO4,pie1$Month,pie1$mm,TRUE)

Description


Usage

data(pie1)

Format

A data frame with 718 observations on the following 4 variables.

Date  sampling date (year+decimals)

mm  amount of precipitation (mm)

SO4  sulphate concentration (mg/L)

NO3  nitrate concentration (mg N/L)

Details

SO4 shows a decreasing trend NO3 and mm show no significant trend
Source


Examples
data(pie1w)

rkt(pie1w$Date,pie1w$SO4)

print.rkt

print Method for class rkt

Description
The results of the test(s) and the slope are printed

Usage
## S3 method for class 'rkt'
print(x, ...)

Arguments
x an object of class rkt, i.e. the output of the rkt function
... any additional argument

Value
NULL

Author(s)
Aldo Marchetto <a.marchetto@ise.cnr.it>

Examples
data(pie1)
ex<rkt(pie1$Year,pie1$SO4,pie1$Month,pie1$mm,TRUE) print(ex)
Description

Computes the Mann-Kendall test (MK) and the Seasonal and the Regional Kendall Tests for trend (SKT and RKT) and Theil-Sen’s slope estimator.
When a covariable is defined, this function also computes partial RKT and SKT.
To allow for non-regular sampling dates, input data should be vectors, not time series.

Usage

rkt(date, y, block, cv, correct = F, rep = "e")

Arguments

date a mandatory vector of numerical data representing dates, as years or years+decimal. If correction for intra-block correlation is required, dates will be truncated to the year, and no more than one value per block per year will be considered. If two equal dates (or truncated dates) are found, the behaviour of the program is determined by rep

y a mandatory vector of measured data. In this vector, missing data are allowed.

block an optional vector of positive integer numbers representing blocks, i.e. sites, seasons or months, or a code combining both sites and seasons/months. If no blocks are defined, the result will be the Mann-Kendall test.

cv an optional vector containing a covariable, such as river flow or deposition amount. In this vector, missing data are allowed

correct a boolean value. If correct is FALSE, no correction for correlation between blocks is performed. If correct is TRUE, dates are truncated and the correction for correlation between blocks is performed. Note that the truncation is performed in any case, while the correction is performed only if there are more than one block, and more than nine years of data. Default value is FALSE.

rep a character value. If rep is set to "a", data sharing the same date (or truncated date if correct is TRUE) are averaged. If rep is set to "m", their median is used. For any other value of rep, an error is produced if two or more data share the same date (or truncated date if correct is TRUE). The latter is the default behaviour of the program.

Details

The MK test for trend analysis was first proposed by Mann (1945).
Hirsch et al. (1982) derived SKT for trend analysis of monthly data in a single site using seasons as the blocking variable, and Helsel and Franse (2006) extended it to a regional test using sites as the blocking variable (RKT).
The correction for correlation among blocks was introduced by Hirsch & Slack (1984), and the
partial test was proposed by Libiseller & Grimvall (2002).
At least 4 data are required for each block.
Correction for correlation between blocks is not performed if less than 10 years of data are available.
If correct is FALSE, data are not required to be sampled monthly or yearly.

Value

A list with class rkt is returned with the following components:

- **sl**: two sided p-value
- **S**: Kendall’s score
- **b**: Theil-Sen’s slope for MK, Seasonal (or Regional) Kendall Slope estimator for SKT and RKT
- **varS**: variance of S
- **sl.corrected**: two sided p-value, after correction for intra-block correlation
- **varS.corrected**: variance of S, after correction for intra-block correlation
- **partial.S**: partial Kendall’s score, if a covariable is present
- **partial.sl**: two sided p-value of the partial test, if a covariable is present
- **partial.varS**: partial variance of S, if a covariable is present
- **partial.sl.corrected**: two sided p-value of the partial test, after correction for intra-block correlation, if a covariable is present
- **partial.varS.corrected**: partial variance of S, after correction for intra-block correlation, if a covariable is present

Note

All items are returned in any case. When a test is not performed, relative items are set to NA.
To consider data sharing the same dates as ties in the time domain, please use Kendall function in the Kendall package.
For time series with multiple detection limits, please refer to the NADA package.
To compare with the Kendall.exe program (Helsel et al. 2004), please use for dates hydrological years (Oct to Sep) instead of calendar years (Jan to Dec).

Author(s)

Aldo Marchetto <a.marchetto@ise.cnr.it>

References

Helsel D.R., Frans L.M. 2006 The regional Kendall test for trend: Environmental Science and Technology 40, 4066–4073


Libiseller C., Grimvall A. 2002 Performance of partial Mann-Kendall tests for trend detection in the presence of covariates. Environmetrics 13, 71-84

Mann H.B. 1945. Nonparametric tests against trend. Econometrica 13, 245-249

See Also
print.rkt

Examples

```r
# monthly data
#
data(pie1)
ex<-rkt(pie1$Year,pie1$SO4,pie1$Month,pie1$mm,TRUE)
print(ex)
# weekly data, no intrablock correction
#
data(pie1w)
ex<-rkt(pie1w$Date,pie1w$SO4)
print(ex)
```

### sign1

**modified sign() function for SKT taking into account missing data**

Description
differ from sign as it return 0 when x is NA

Usage

```
sign1(x)
```
Arguments
x any number

Value
1 if x > 0 -1 if x < 0 0 if x = 0 or x = NA

Note
used by rkt

Author(s)
Aldo Marchetto

References

See Also
rkt

Examples
a<-1
sign1(a)
a<-NA
sign1(a)
Index

*Topic datasets
  piel, 3
  pielw, 4

*Topic math
  sign1, 8

*Topic nonparametric
  rkt, 6

*Topic package
  rkt-package, 2

*Topic print
  print.rkt, 5

*Topic ts
  rkt, 6
  rkt-package, 2

 piel1, 3
 piel1w, 4
 print.rkt, 5

 rkt, 6
 rkt-package, 2

 sign1, 8

tkt (rkt-package), 2
tkt-package (rkt-package), 2