Package ‘pcts’

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Type Package

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     https://github.com/GeoBosh/pcts/ (devel)

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License GPL (>= 2)

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Description

Details

The underlying assumption is that the observations are made at regular intervals, such as quarter, month, week, day — or represent data for such intervals — and these intervals are nested into larger periods. In pcts we call the larger period a cycle and its parts seasons. Typical examples of season-cycle timing are months in a year, quarters in a year, days in a week (or business week). The number of seasons in a cycle is called frequency in class "ts" in base R.

Cycles in pcts keep not only the number of seasons (frequency) but other information, such as the names of the seasons and units of seasons. In pcts there are a number of builtin cycle classes for typical cases, as well as provision for creation of custom cycles on the fly. See pcCycle and BuiltinCycle for ways to create cycle objects, and allSeasons for further examples.

Periodic time series can be created with pcts, which accepts as input vectors, matrices and time series objects from base R and some other packages, including zoo and xts. When importing data, the time information is taken from the data and an attempt is made to guess the periodicity from the frequency (for time series objects that have it set) and an analysis of the datetime stamps, if present. pcts also has arguments for specifying the number of seasons or the cycle, as well as the start datetime.

The main periodic time series classes in pcts are PeriodicTS and PeriodicMTS, for univariate and multivariate time series, respectively. Standard time series functions can be used with them directly, see for example window and start.

The naming conventions are as follows. Names of classes generally consists of one or more words. The first letter of each word, is capitalised. Only the first letter of abbreviations for models, such as ARMA, is capitalised. Similarly for generic functions but for them the first word is not capitalised. In a few names PM stands for ‘periodic model’ and TS for ‘time series’.

Significant portion of the code was written in 2005–2007. Many of the functions and classes have been renamed under the above conventions and most of those that are not are not exported but a few still are and they should be considered subject to change.

Autocovariances and autocorrelations are one-stop generic functions for computation of these second order properties. What to compute is deduced from the type of the object. For models they compute theoretical quantities — periodic or non-periodic, scalar or multivariate. For time series they compute the corresponding sample counterparts.

Author(s)

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References


See Also

mcompanion

Examples

data(dataFranses1996)
class(dataFranses1996) # [1] "mts" "ts" "matrix"

pcts(dataFranses1996)

pcfr <- pcts(dataFranses1996)
class(pcfr) # "PeriodicMTS"
nSeasons(pcfr) # 4
allSeasons(pcfr)
allSeasons(pcfr, abb = TRUE)

## subsetting
## one index, x[i], is analogous to lists
pcfr2to4 <- pcfr[2:4]; class(pcfr2to4) # "PeriodicMTS"
pcter2to2 <- pcfr[2]; class(pcfr2to2) # "PeriodicMTS"
pcter2 <- pcfr[[2]]; class(pcfr2) # note '[[", "PeriodicTS"

## data for 1990 quarter 3
pcter2to4[as_date("1990-07-01")]

## with empty index, returns the underlying data
dim(pcfr[]) # [1] 148 19
dim(pcfr2to2[]) # 148 1
length(pcfr2[]) # 148 (this is numeric)

summary(pcfr2)
summary(pcfr2to4)

## make the output width shorter
summary(pcfr2to4, row.names = FALSE)
summary(pcfr2to4, row.names = 5) # trim row names to 5 characters

head(pcfr2to4) # starts with NA's
tail(pcfr2to4) # some NA's at the end too

## time of first and last data, may be NA's
start(pcfr2to4) # 1955 Q1
end(pcfr2to4) # 1991 Q4

## time of first nonNA:
availStart(pcfr2) # 1955 Q1
availStart(pcfr2to4) # 1955 Q1

## time of last nonNA:
availEnd(pcfr2[]) # 1991 Q4
availEnd(pcfr2to4[]) # 1987 Q4
availEnd(pcfr2[]) # 1990 Q4
allSeasons

Get names of seasons

Description

Functions and methods for get names of seasons and related quantities for objects from the cycle, periodic time series classes and other objects for which the concepts are defined.

Usage

unitSeason(x)
unitCycle(x)
seqSeasons(x)
allSeasons(x, abb = FALSE, prefix = "S", ...)

unitSeason ( x, ... ) <- value
unitCycle ( x, ... ) <- value
allSeasons ( x, abb, ... ) <- value

## S4 replacement method for signature 'SimpleCycle'
allSeasons(x, abb, prefix, ...) <- value

## S4 replacement method for signature 'Cyclic'
allSeasons(x, abb = FALSE, ...) <- value

Arguments

x a cycle, time series or other object for which the concept of seasons is defined.
abb if TRUE give the abbreviated names of the seasons.
prefix use this prefix for automatically generated names of seasons.
... further arguments for methods.
value a character string
allSeasons

Details

The cycle classes, i.e. classes inheriting from class BasicCycle, provide common functionality. In particular, they guarantee that the functions described in this topic are available. These functions work also for the periodic time series classes and may be defined for other classes where they make sense.

Methods

Methods for allSeasons():

signature(x = "BasicCycle", abb = "ANY")
signature(x = "DayWeekCycle", abb = "logical")
signature(x = "DayWeekCycle", abb = "missing")
signature(x = "FiveDayWeekCycle", abb = "logical")
signature(x = "FiveDayWeekCycle", abb = "missing")
signature(x = "MonthYearCycle", abb = "logical")
signature(x = "MonthYearCycle", abb = "missing")
signature(x = "OpenCloseCycle", abb = "logical")
signature(x = "OpenCloseCycle", abb = "missing")
signature(x = "QuarterYearCycle", abb = "logical")
signature(x = "QuarterYearCycle", abb = "missing")
signature(x = "SimpleCycle", abb = "ANY")
signature(x = "Cyclic", abb = "ANY")
signature(x = "Every30MinutesCycle", abb = "logical")
signature(x = "Every30MinutesCycle", abb = "missing")
signature(x = "VirtualPeriodicModel", abb = "ANY")

Author(s)

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Examples

opcycle <- new("OpenCloseCycle")
## convert to SimpleCycle to change some names
siopcycle <- as(opcycle, "SimpleCycle")
## siopcycle inherits names from opcycle
unitSeason(siopcycle) # "Season"
unitCycle(siopcycle) # "Cycle"
allSeasons(siopcycle) # "Open" "Close"
allSeasons(siopcycle, abb = TRUE) # "O" "C"

allSeasons(siopcycle) <- c("Day", "Night")
allSeasons(siopcycle) # now: "Day" "Night"
## change also abbreviations
allSeasons(siopcycle, abb = TRUE) <- c("D", "N")
allSeasons(siopcycle, abb = TRUE) # now: "D" "N"

seasons <- new("SimpleCycle", 4)
unitSeason(seasons) # "Season"
unitCycle(seasons) # "Cycle"
allSeasons(seasons)
allSeasons(seasons, abb = TRUE)

unitCycle(seasons) <- "Year"
unitCycle(seasons)
allSeasons(seasons) <- c("Winter", "Spring", "Summer", "Autumn")
allSeasons(seasons)
allSeasons(seasons, abb = TRUE) <- c("Win", "Spr", "Sum", "Aut")
allSeasons(seasons, abb = TRUE)

## change autumn to Fall
allSeasons(seasons)[4] <- "Fall"
allSeasons(seasons, abb = TRUE)[4] <- "Fal"
allSeasons(seasons)
allSeasons(seasons, abb = TRUE)

## indexing of cycle objects is equivalent to allSeasons.
seasons[]
seasons[, abb = TRUE]

seasons[4] <- "Herbst"
seasons

unitCycle(seasons) <- "Jahre"
unitCycle(seasons)
unitSeason(seasons) <- "Jahreszeit"
seasons[] <- c("Winter", "Fruehling", "Sommer", "Herbst")
seasons[, abb = TRUE] <- c("W", "F", "S", "H")
seasons[]
seasons

---

**as_date-methods**

Replace methods for as_date in package pcts

---

**Description**

Replace methods for as_date in package pcts.

**Methods**

signature(x = "PeriodicTimeSeries")
signature(x = "ANY")
signature(x = "character")
Description

Methods for as_datetime in package pcts.

Methods

signature(x = "PeriodicTimeSeries")

autocorrelations-methods

Description

Methods for computation of autocorrelations and periodic autocorrelations.

Methods

signature(x = "numeric", maxlag = "ANY", lag_0 = "missing")
signature(x = "PeriodicTimeSeries", maxlag = "ANY", lag_0 = "missing")
signature(x = "PeriodicAutocovariances", maxlag = "ANY", lag_0 = "missing")
signature(x = "SamplePeriodicAutocovariances", maxlag = "ANY", lag_0 = "missing")
signature(x = "VirtualPeriodicAutocovariances", maxlag = "ANY", lag_0 = "missing")
signature(x = "VirtualPeriodicAutocovarianceModel", maxlag = "ANY", lag_0 = "missing")

See Also

autocovariances-methods for autocovariances; autocorrelations in package "sarima" for further details.
Examples

```r
## periodic
autocorrelations(pcts(AirPassengers), maxlag = 10)

## for "ts" or "numeric" objects the default is non-periodic
## non-periodic acf
autocorrelations(AirPassengers, maxlag = 10)
autocorrelations(as.numeric(AirPassengers))
## argument 'nseasons' forces periodic acf
autocorrelations(AirPassengers, maxlag = 10, nseasons = 12)
autocorrelations(as.numeric(AirPassengers), maxlag = 10, nseasons = 12)
```

autocovariances-methods

`Compute autocovariances and periodic autocovariances`

Description

Methods for the generic function `autocovariances()`, which computes autocovariances meaningful for the first argument. For objects representing time series, it computes sample autocovariances (univariate, multivariate, periodic, as appropriate). For objects representing models, it computes the relevant theoretical autocovariances.

Methods

```r
signature(x = "matrix", maxlag = "ANY")
signature(x = "numeric", maxlag = "ANY")
signature(x = "PeriodicArmaModel", maxlag = "ANY")
signature(x = "PeriodicArModel", maxlag = "ANY")
signature(x = "PeriodicAutocovarianceModel", maxlag = "ANY")
signature(x = "PeriodicTS", maxlag = "ANY")
signature(x = "VirtualPeriodicAutocovariances", maxlag = "ANY")
```

If `maxlag` is missing or equal to `maxLag(x)`, `x` is returned unchanged. Otherwise the number of available lags is adjusted to `maxlag`.

See Also

`autocorrelations-methods` for autocorrelations; autocovariances in package "sarima" for further details.
**availStart**  
*Time of first or last non-NA value*

**Description**
Time of first or last non-NA value.

**Usage**

```
availStart(x, any = TRUE)
availEnd(x, any = TRUE)
```

**Arguments**

- `x`: a time series or similar object 
- `any`: logical flag for multivariate objects. The default `TRUE` requests the first/last index containing any non-NA value. `FALSE` requires that all values at the first/last index must be non-NA.

**Details**

The time is given as a cycle-season pair.

Argument `any` is meaningful only for multivariate objects. Its name is short for "the first/last index for which any of the values (ie at least one) is non-NA". `any = FALSE` is taken to mean that the index is the first/last for which all values are non-NA.

The functions can be used together with `windows` to trim NA's from the beginning and/or end of the data. As an alternative we provide also methods for periodic time series methods for `zoo::na.trim`, see the examples below.

**Value**
numeric, length 2

**See Also**

`window`

**Examples**

```r
  tipi <- pcts(dataFranses1996[, "USTotalIPI"])
  start(tipi)
  end(tipi)
  head(tipi)
  tail(tipi)
  tipi <- window(tipi, start = availStart(tipi), end = availEnd(tipi))
```
start(tipi)
end(tipi)
plot(tipi)

pcfr <- pcts(dataFranses1996)

pcfr2to4 <- pcfr[2:4]
head(pcfr2to4)
tail(pcfr2to4)
## time of first and last data, can be NA's
start(pcfr2to4) # 1955 Q1
end(pcfr2to4)   # 1991 Q4

## time of first nonNA:
availStart(pcfr[[2]]) # 1960 Q1
availStart(pcfr2to4) # 1960 Q1

## time of last nonNA:
availEnd(pcfr[[2]]) # 1991 Q4
availEnd(pcfr[[3]]) # 1987 Q4
availEnd(pcfr[[4]]) # 1990 Q4
## but at least one of them is available for 1991 Q4, so:
availEnd(pcfr2to4) # 1991 Q4
## this requests the time of the last full record:
availEnd(pcfr2to4, any = FALSE) # 1987 Q4

pcfr2to4a <- window(pcfr2to4, start = availStart(pcfr2to4), end = availEnd(pcfr2to4))
head(pcfr2to4a)
tail(pcfr2to4a, 20)

## trim NA's from both ends, up to the first/last full record:
pcfr2to4b <- window(pcfr2to4, start = availStart(pcfr2to4, FALSE),
                   end = availEnd(pcfr2to4, FALSE))

## TODO: need a better example here since the first non-NA value for all
## ts in pcfr2to4 is at the same
## alternatively, use na.trim(), the default for is.na is "any"
pcpres <- window(pcts(presidents), end = c(1972, 4))

availStart(pcpres) # 1945 2
availEnd(pcpres)   # 1972 2

both <- na.trim(pcpres) # same as "both"
identical(na.trim(pcpres), both) # TRUE
head(both, 7)
tail(both)
head(na.trim(pcpres, "left"), 7)
tail(na.trim(pcpres, "right"))

cguk <- pcfr[c("CanadaUnemployment", "GermanyGNP", "UKTotalInvestment")]
availStart(cguk)
availStart(cguk, TRUE) # same
BareCycle-class

Description

Class BareCycle.

Objects from the Class

Objects can be created by calls of the form pcCycle(nseasons) or new("BareCycle", nseasons). Class "BareCycle" represents the number of seasons and is sufficient for many computations.

Slots

nseasons: Object of class "integer", the number of seasons.

Extends

Class "BasicCycle", directly.

Methods

coerce signature(from = "BuiltinCycle", to = "BareCycle"): ...
initialize signature(.Object = "BareCycle"): ...

nSeasons signature(object = "BareCycle"): ...
show signature(object = "BareCycle"): ...

Author(s)

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See Also

pcCycle for creation of cycle objects and extraction of cycle part of time series,
BuiltinCycle-class, SimpleCycle-class,
DayWeekCycle-class, MonthYearCycle-class, OpenCloseCycle-class, QuarterYearCycle-class
PartialCycle-class,
BasicCycle-class (virtual, for use in signatures)

Examples

pcCycle(5)
cycle <- new("BareCycle", 5)
identical(new("BareCycle", 5), pcCycle(5)) # TRUE

unitSeason(cycle)
unitCycle(cycle)
allSeasons(cycle)
seqSeasons(cycle)

cycle[]
cycle[3]

## if cycle represents 5-days week one may prefer:
BuiltinCycle(5)

BasicCycle-class  Class BasicCycle

Description

Class BasicCycle.

Objects from the Class

A virtual Class: No objects may be created from it.

Methods

[ signature(x = "BasicCycle",i = "ANY",j = "missing",drop = "ANY")
[ signature(x = "BasicCycle",i = "missing",j = "missing",drop = "ANY")
[< signature(x = "BasicCycle",i = "ANY",j = "missing",value = "ANY")
[< signature(x = "BasicCycle",i = "missing",j = "missing",value = "ANY")
allSeasons signature(x = "BasicCycle",abb = "ANY")
seqSeasons signature(x = "BasicCycle")
Author(s)

Georgi N. Boshnakov

See Also

BareCycle-class, SimpleCycle-class, BuiltinCycle-class
DayWeekCycle-class, MonthYearCycle-class, OpenCloseCycle-class, QuarterYearCycle-class,
PartialCycle-class

Examples

showClass("BasicCycle")

BuiltinCycle-class  Class "BuiltinCycle" and its subclasses in package 'pcts'

Description

Class "BuiltinCycle" and its subclasses in package 'pcts'.

Objects from the Class

Class "BuiltinCycle" is a virtual Class: no objects may be created from it. Class "BuiltinCycle" has several built-in cycle subclasses. Objects from the subclasses can be created by calls of the form new("className",first,...), where "className" is the name of the subclass. The optional argument first can be used to designate a season to be considered first in the cycle, by default the first.

The function BuiltinCycle provides a more convenient way to generate objects from subclasses of class "BuiltinCycle". Its argument is the number of seasons.

These classes are effectively unmodifiable, but the user can convert them to other cycle classes, e.g. class "SimpleCycle", and adapt as needed.

The subclasses of "BuiltinCycle" have definitions for all methods promised by its superclass "BasicCycle".

Slots

The class "BuiltinCycle" and its subclasses have a single common slot:

first: Object of class "integer", the index of the season to be treated as the first in a cycle.

Extends

Class "BuiltinCycle" extends class "BasicCycle", directly.
Classes "DayWeekCycle", "Every30MinutesCycle", "FiveDayWeekCycle", "OpenCloseCycle" and "QuarterYearCycle" extend:
Class "BuiltinCycle", directly. Class "BasicCycle", by class "BuiltinCycle", distance 2.
Methods

Functions with methods for this class:

- **coerce** signature(from = "BuiltinCycle", to = "BareCycle"): ...
- **coerce** signature(from = "BuiltinCycle", to = "SimpleCycle"): ...
- **initialize** signature(.Object = "BuiltinCycle"): ...
- **show** signature(object = "BuiltinCycle"): ...
- **allSeasons** signature(x = "DayWeekCycle", abb = "logical")
- **allSeasons** signature(x = "DayWeekCycle", abb = "missing")
- **nSeasons** signature(object = "DayWeekCycle")
- **unitCycle** signature(x = "DayWeekCycle")
- **unitSeason** signature(x = "DayWeekCycle")
- **allSeasons** signature(x = "Every30MinutesCycle", abb = "logical"): ...
- **allSeasons** signature(x = "Every30MinutesCycle", abb = "missing"): ...
- **nSeasons** signature(object = "Every30MinutesCycle"): ...
- **unitCycle** signature(x = "Every30MinutesCycle"): ...
- **unitSeason** signature(x = "Every30MinutesCycle"): ...
- **allSeasons** signature(x = "FiveDayWeekCycle", abb = "logical"): ...
- **allSeasons** signature(x = "FiveDayWeekCycle", abb = "missing"): ...
- **nSeasons** signature(object = "FiveDayWeekCycle"): ...
- **unitCycle** signature(x = "FiveDayWeekCycle"): ...
- **unitSeason** signature(x = "FiveDayWeekCycle"): ...
- **allSeasons** signature(x = "MonthYearCycle", abb = "logical"): ...
- **allSeasons** signature(x = "MonthYearCycle", abb = "missing"): ...
- **nSeasons** signature(object = "MonthYearCycle"): ...
- **unitCycle** signature(x = "MonthYearCycle"): ...
- **unitSeason** signature(x = "MonthYearCycle"): ...
- **allSeasons** signature(x = "OpenCloseCycle", abb = "logical"): ...
- **allSeasons** signature(x = "OpenCloseCycle", abb = "missing"): ...
- **nSeasons** signature(object = "OpenCloseCycle"): ...
- **unitCycle** signature(x = "OpenCloseCycle"): ...
- **unitSeason** signature(x = "OpenCloseCycle"): ...
- **allSeasons** signature(x = "QuarterYearCycle", abb = "logical"): ...
- **allSeasons** signature(x = "QuarterYearCycle", abb = "missing"): ...
- **nSeasons** signature(object = "QuarterYearCycle"): ...
- **unitCycle** signature(x = "QuarterYearCycle"): ...
- **unitSeason** signature(x = "QuarterYearCycle"): ...
Author(s)

Georgi N. Boshnakov

See Also

BuiltinCycle, pcCycle for creation of cycle objects and extraction of cycle part of time series, 
BareCycle-class, SimpleCycle-class.

Examples

## class "DayWeekCycle"
dwcycle <- BuiltinCycle(7) # new("DayWeekCycle")

unitSeason(dwcycle)
unitCycle(dwcycle)

allSeasons(dwcycle)
dwcycle[] # same

allSeasons(dwcycle, abb = TRUE)
dwcycle[ , abb = TRUE] # same

dwcycle[2]
dwcycle[2, abb = TRUE]

seqSeasons(dwcycle)

## start the week on Sunday
dws <- BuiltinCycle(7, first = 7) # new("DayWeekCycle", first = 7)
dws[1] # "Sunday"
allSeasons(dws)

## class "Every30MinutesCycle"
cyc48 <- BuiltinCycle(48) # new("Every30MinutesCycle")
nSeasons(cyc48)
allSeasons(cyc48)

## class "FiveDayWeekCycle" is deprecated, use the equivalent:
fdcycle <- BuiltinCycle(5)

unitSeason(fdcycle)
unitCycle(fdcycle)

allSeasons(fdcycle)
fdcycle[] # same

allSeasons(fdcycle, abb = TRUE)
fdcycle[ , abb = TRUE] # same

fdcycle[2]
fdcycle[2, abb = TRUE]
seqSeasons(fdcycle)

## class "MonthYearCycle"
mycycle <- BuiltinCycle(12) # new("MonthYearCycle")

unitSeason(mycycle)
unitCycle(mycycle)

allSeasons(mycycle)
mycycle[ ] # same

allSeasons(mycycle, , abb = TRUE)
mycycle[ , abb = TRUE] # same

mycycle[2]
mycycle[2, abb = TRUE]

seqSeasons(mycycle)

## class "OpenCloseCycle"
opcycle <- new("OpenCloseCycle")

unitSeason(opcycle)
unitCycle(opcycle)

allSeasons(opcycle)
opcycle[ , abb = FALSE] # same

allSeasons(opcycle, abb = FALSE)
opcycle[] # same

opcycle[2]
opcycle[2, abb = TRUE]

seqSeasons(opcycle)

## class "QuarterYearCycle"
qycycle <- new("QuarterYearCycle")

unitSeason(qycycle)
unitCycle(qycycle)

allSeasons(qycycle)
qycycle[] # same

allSeasons(qycycle, abb = TRUE)
qycycle[ , abb = TRUE] # same

qycycle[2]
qucycle[2, abb = TRUE]

seqSeasons(qycycle)
Cyclic

Create objects from class Cyclic

Description

Create objects from class Cyclic.

Usage

Cyclic(cycle, start = NULL, ...)

## S3 method for class 'Cyclic'
as.Date(x, ...)

## S3 method for class 'Cyclic'
date(x)

## S3 method for class 'PeriodicTimeSeries'
as.Date(x, ...)

Arguments

- cycle: A cycle object, a positive integer giving the number of seasons, or any other object that can be used to create a cycle with pcCycle(x, ...).
- start: A cycle-season pair, a datetime object, a Date object or any object that can be converted to datetime with as_datetime(start).
- ...: For Cyclic, arguments passed to pcCycle, used only if cycle is not from a cycle class.
- x: A Cyclic object

Value

For Cyclic, an object from class "Cyclic"

See Also

BuiltinCycle, pcCycle for creation of cycle objects.
pcts importing and creating periodic time series

Examples

## bare bone Cyclic starting at Cycle 1, season 1
Cyclic(4)
Cyclic(4, c(1,1)) # same

## with quarter/year cycle
qu <- Cyclic(BuiltinCycle(4), start = c(2020, 1))
Cyclic-class

```
start(qu)
as_datetime(qu)

date(qu) <- c(2009, 2)

qu <- pcts(AirPassengers)
as.Date(ap)
```

---

**Description**

Class "Cyclic"

**Objects from the Class**

Objects can be created by calls of the form `new("Cyclic", ...)`.

**Slots**

cycle: Object of class "BasicCycle" ~~
pcstart: Object of class "ANY" ~~

**Methods**

- `nSeasons` signature(object = "Cyclic"): ...
- `pcCycle` signature(x = "Cyclic", type = "ANY"): ...
- `allSeasons` signature(x = "Cyclic", abb = "ANY"): ...
- `allSeasons<-` signature(x = "Cyclic"): ...
- `seqSeasons` signature(x = "Cyclic"): ...
- `unitCycle` signature(x = "Cyclic"): ...
- `unitCycle<-` signature(x = "Cyclic"): ...
- `unitSeason` signature(x = "Cyclic"): ...
- `unitSeason<-` signature(x = "Cyclic"): ...

**Examples**

`showClass("Cyclic")`
Example data from Franses (1996)

Description

A multivariate time series containing the data used in examples by Franses (1996).

Usage

data("dataFranses1996")

Format

A multivariate quarterly time series.

Details

Each column is a quarterly time series. The time series start and end at different times, so NA’s are used to align them in a single multivariate time series. Detailed account of the sources of the data is given by Franses (1996; Data Appendix, p. 214).

year (column 1)

The time formatted as yyyy.Q, where yyyy is the year and Q is the quarter (one of 1, 2, 3 or 4.). This column was part of the original data but is not really needed here since the time series object contains the time information.

USTotalIPI (column 2)


CanadaUnemployment (column 3)


GermanyGNP (column 4)

Real GNP in Germany, 1960.1 - 1990.4.

UKTotalInvestment (column 5)


SA_USTotalIPI (column 6) Seasonally adjusted USTotalIPI.

SA_CanadaUnemployment (column 7)

Seasonally adjusted CanadaUnemployment.

SA_GermanyGNP (column 8)

Seasonally adjusted GermanyGNP.

UKGDP (column 9)


UKTotalConsumption (column 10)

\textit{UKNondurablesConsumption} (column 11)

\textit{UKExport} (column 12)

\textit{UKImport} (column 13)

\textit{UKPublicInvestment} (column 14)

\textit{UKWorkforce} (column 15)

\textit{SwedenNondurablesConsumption} (column 16)

\textit{SwedenDisposableIncome} (column 17)

\textit{SA_SwedenNondurablesConsumption} (column 18)
Seasonally adjusted \textit{SwedenNondurablesConsumption} with Census X-11 method, 1964.1–1988.1. (Using the approximate linear Census X-11 filter given in Table 4.1, p. 52 in Franses (1996) and generating the forecasts and backcasts as described in Ooms (1994)).

\textit{SA_SwedenDisposableIncome} (column 19)
Seasonally adjusted \textit{SwedenDisposableIncome} with Census X-11 method, 1964.1–1988.1. (Using the same method as above.)

More details on the individual time series are given by Franses (1996).

\textbf{Note}
Most of the time series in \textit{dataFranses1996} are available as separate datasets in package ‘partsm’. The numbers should be the same but note that, at the time of writing this, not all datasets there carry complete time information.

\textbf{Source}
The data were downloaded from http://people.few.eur.nl/franses/research/data/data1.txt, but this link is now broken.

\textbf{References}
**Examples**

```r
data(dataFranses1996)
class(dataFranses1996)
colnames(dataFranses1996)
dim(dataFranses1996) # c(148, 19)
plot(dataFranses1996[, 2:11])

tipi <- dataFranses1996[, "USTotalIPI"]
plot(tipi)

## convert to PeriodicTS and remove NA’s at the start and end
pctipi <- pcts(tipi)
pctipi <- window(pctipi, start = availStart(pctipi), end = availEnd(pctipi))
plot(pctipi)

## convert the whole dataset to class "PeriodicMTS"
pcfr <- pcts(dataFranses1996)

colnames(pcfr)[2:3] # "USTotalIPI" "CanadaUnemployment"

## subset as "PeriodicMTS"
pcfr2to3 <- pcfr[2:3]
plot(pcfr2to3)

## "[" "PeriodicMTS" even with length one arg.
pcfr2to2 <- pcfr[2]
pcfr2to2a <- pcfr["USTotalIPI"] # same

## use "[[" or $ to get "PeriodicTS"
pcfr2 <- pcfr[[2]]

pcfr2a <- pcfr[["USTotalIPI"]]

pcfr2b <- pcfr$USTotalIPI # same

identical(pcfr2, pcfr2a) # TRUE
identical(pcfr2, pcfr2b) # TRUE

cycle(pcfr)
frequency(pcfr)
```

---

**date<--methods**

*Replace methods for date in package pcts*

**Description**

Replace methods for date in package pcts.

**Methods**

```r
signature(x = "BasicCycle")
signature(x = "Cyclic")
```
Description

ex1 is the autocorrelation function used in the reference as an example when the solution of the periodic Yule-Walker system gives an invalid PAR model. This can happen only if Lambert-Lacroix’s condition on the PAR order is not satisfied, see pdSafeParOrder.

Format

A function of two arguments

Source


References


See Also

pdSafeParOrder

Examples

data(ex1f)
## compute the first few autocorrelations
pc3 <- slMatrix(period = 2, maxlag = 5, f = ex1f, type = "tt")
## Fir a PAR(0,2) model
res0p2 <- alg1(pc3[,c(0,2)])
## model is invalid since a partial autocorrelation is larger than one:
res0p2$be
## Find a modified order:
pdSafeParOrder(c(0,2)) # PAR(1,2)
## now the parcor's are fine:
res1p2 <- alg1(pc3[,c(1,2)])
res1p2$be
filterCoef-methods

Get the coefficients of a periodic filter

Description

Get the coefficients of a periodic filter.

Details

filterCoef is a generic function to extract the coefficients of periodic filters. Argument convention can be used to force a particular convention for the signs. The description here is for the methods defined in this package.

If convention is missing, the coefficient matrix is returned as stored in the object. Otherwise, if convention is one of the strings "BJ", "--" or "-", the coefficients returned have the opposite sign of those in the auxiliary polynomial (Box-Jenkins' convention). if convention is one of "SP", "++" or "+", the coefficients are as in the auxiliary polynomial (convention used in signal processing).

Value

a matrix

Methods

signature(object = "PeriodicBJFilter", convention = "character")
signature(object = "PeriodicSPFilter", convention = "character")

fitPM

Fit periodic time series models

Description

Generic function with methods for fitting periodic time series models.

Usage

fitPM( model, x, ...)

Arguments

x the time series.
model a periodic model, see Details.
... further arguments to be passed on to individual methods.
Details

This is a generic function. model provides the specification of the model. In particular, the class of model determines what model is fitted. Specific values of the parameters are generally ignored by non-iterative methods but some methods can handle more detailed specifications, see the individual methods.

Value

the fitted model, typically an object of class `class(model)`

Methods

signature(model = "ANY", x = "ANY") This is the default method. It simply exits with an error message stating that fitPM does not have a method for the model specified by model.

signature(model = "numeric", x = "ANY") Fits a PAR model to x. model should be a vector of non-negative integers giving the PAR order. The length of this vector is taken to be the number of seasons.

This is a convenience method. It constructs a PAR model and calls the method for model = "PeriodicArModel".

signature(model = "PeriodicArModel", x = "ANY") Fits a PAR model.

signature(model = "mcSpec", x = "ANY") Fits a periodic model according to the specification given by model.

Currently this method uses mC.ss to set up the optimisation environment and then calls one of the optimisation functions in that environment as specified by argument optim.method, see below.

Additional arguments may be specified to control the optimisation.

Argument init can be used to give initial values. It is passed on to mC.ss (and so has the format required by it).

optim.method is the name of an optimisation function in the environment returned by mC.ss. The default is optim.method = "minim", which is based on the standard R function optim. Alternatives are "minimBB" or "minimBBLU". All this needs to be documented but see mC.ss and xx.ss for details.

Further arguments are passed on to the optimisation method. A typical argument supported by most optimisation functions is control.

signature(model = "PiPeriodicArModel", x = "ANY") Fits a periodically integrated PAR model using the parameters of model as initial values. Calls pclspiar to do the actual work.

signature(model = "SiPeriodicArModel", x = "ANY") Fits a seasonally integrated PAR model.

signature(model = "PeriodicArModel", x = "PeriodicMTS")

signature(model = "PeriodicArModel", x = "PeriodicTS")

Author(s)

Georgi N. Boshnakov
References
(todo: to be completed properly later)


Examples

```r
## newm1 <- list(phi = matrix(1:12, nrow=4), p=rep(3,4), period=4, si2 = rep(1,4))
## new_pfm1 <- PeriodicFilterModel(newm1, intercept=0)

## generate some data;
set.seed(1234)
simts1 <- pcts(rnorm(1024), nseasons = 4)

fitPM(c(3,3,3,3), simts1)
fitPM(3, simts1)
## the fit on the underlying data is equivalent.
fitPM(c(3,3,3,3), as.numeric(simts1))

## equivalently, use a PAR(3,3,3,3) model for argument 'model'
## here the coefficients of pfm1 are ignored, since the estimation is linear.
pfm1 <- PeriodicArModel(matrix(1:12, nrow = 4), order = rep(3,4), sigma2 = 1)
pfm1
## these give same results as above
fitPM(pfm1, simts1)
fitPM(pfm1, as.numeric(simts1))

fitPM(c(1,1,1,1), simts1)
fitPM(c(3,2,2,1), simts1)
fitPM(c(3,2,2,2), simts1)

pdSafeParOrder(c(3,2,2,1))
pdSafeParOrder(rev(c(3,2,2,1)))

x <- arima.sim(list(ar = 0.9), n = 960)
pcx <- pcts(x, nseasons = 4)
mx <- matrix(x, nrow = 4)

##pc.acf(mx)
##pc.acf(mx, maxlag=10)
## TODO: avoid the warning when length of the time series is not multiple
autocovariances(t(mx), maxlag = 6, nseasons = 4)
autocovariances(t(mx))

##It is an error to have more columns than rows.
## autocovariances(mx, maxlag = 6, nseasons = 4)
## autocovariances(mx)
```
num2pcpar(mx, c(1,1,1), period = 4)
num2pcpar(mx, c(3,3,3), period = 4)

sipfm1 <- new("SiPeriodicArModel", iorder = 1, siorder = 1, pcmodel = pfm1)
sipfm1
fitPM(sipfm1, mx)
pfm1

## experiments and testing
fit1 <- fitPM(c(3,3,3,3), simts1)
fit1_mf <- new("MultiFilter", coef = fit1@ar@coef)
vs <- mcompanion::mf_VSform(fit1_mf, form = "I")
tmp <- mcompanion::VAR2pcfilter(vs$Phi[, -4],
    Phi0inv = vs$Phi0inv, D = fit1@sigma2, what = "")
(names(tmp) # "pcfilter" "var" "Uform"
tmp$var
zapsmall(tmp$pcfilter)
fit1@ar@coef
all.equal(tmp$pcfilter[, 1:3], fit1@ar@coef, check.attributes = FALSE) # TRUE
tmp$Uform
fit1@sigma2

## both give the matrix Sigma for the "I" form
identical(
    vs$Phi0inv
,    tmp$Uform$U0inv
) # TRUE

## no, this is a different matrix
var1_mat <- cbind(vs$Phi0, # identity matrix
    - vs$Phi) # drop trailing zero columns?
var1_mat <- mcompanion::mCompanion(var1_mat)
var1_Sigma <- vs$Phi0inv
abs(eigen(diag(nrow(var1_mat)) - var1_mat)$values)

---

FittedPeriodicArmaModel-class

Class FittedPeriodicArmaModel

Description

Class FittedPeriodicArmaModel in package pcts

Objects from the Class

Objects can be created by calls of the form new("FittedPeriodicArmaModel",...,mean).
FittedPeriodicArModel-class

Slots

ar: Object of class "PeriodicBJFilter" ~-
ma: Object of class "PeriodicSPFilter" ~-
modelCycle: Object of class "BasicCycle" ~-
center: Object of class "numeric" ~-
intercept: Object of class "numeric" ~-
sigma2: Object of class "numeric" ~-
theTS: Object of class "PeriodicTS" ~-
asyCov: Object of class "ANY" ~-
ns: Object of class "numeric" ~-

Extends


Methods

as_parma_list signature(object = "FittedPeriodicArmaModel"): ...
show signature(object = "FittedPeriodicArmaModel"): ...

FittedPeriodicArModel-class

Class FittedPeriodicArModel

Description

Class FittedPeriodicArModel.

Objects from the Class

Objects can be created by calls of the form new("FittedPeriodicArModel", ar, ma, sigma2,...).
fit_trigPAR_optim

Slots

asYcov: Object of class "ANY" ~~
sigma2: Object of class "numeric" ~~
ar: Object of class "PeriodicArFilter" ~~
ma: Object of class "PeriodicMaFilter" ~~
center: Object of class "numeric" ~~
intercept: Object of class "numeric" ~~
theTS: Object of class "PeriodicTS" ~~
ns: Object of class "numeric" ~~
modelCycle: Object of class "BasicCycle" ~~

Extends


Methods

No methods defined with class "FittedPeriodicArModel" in the signature.

show signature(object = "FittedPeriodicArModel"): ...

summary signature(object = "FittedPeriodicArModel"): ...

fit_trigPAR_optim Fit a subset trigonometric PAR model

Description

Fit a subset PAR model with trigonometric parameterisation.

Usage

fit_trigPAR_optim(x, order, nseasons, seasonof1st = 1, maxiter = 200, harmonics = NULL, sintercept = FALSE, tol = 1e-07, type = c("vecbyrow", "bylag"), verbose = TRUE)
**Arguments**

- `x` time series.
- `order` order, an integer number.
- `nseasons` number of seasons, an integer number.
- `seasonof1st` season of the first observation.
- `maxiter` max number of iterations.
- `harmonics` the harmonics to include in the model, vector of non-negative integers.
- `sintercept` if TRUE include seasonal intercept.
- `tol` when to stop the iterations.
- `type` type of parameterisation, currently one of "vecbyrow" or "bylag".
- `verbose` if TRUE print more details during estimation.

**Details**

Fits a subset PAR model using trigonometric parameterisation, i.e. Fourier series written in terms of sines and cosines.

If argument `type` is `bylag`, the parameters for each lag are parameterised independently from other lags. If `sintercept` is `TRUE`, it has its own trigonometric representation.

If argument `type` is `vecbyrow` ("Vec operation by row"), the PAR parameters are stacked in a vector with all parameters for the first season, followed by all parameters for the second, and so on. The trigonometric parameterisation for this vector is used. So the fundamental frequency is $1/(\text{nseasons} \times \text{order})$. If `sintercept` is `TRUE` when `type = vecbyrow`, then the intercept for each season is put before the PAR parameters and the fundamental frequency becomes $1/(\text{nseasons} \times (\text{order} + 1))$. Putting together the intercepts and the PAR parameters may not be very useful for parsimonious trigonometric parameterisation, so to have a separate set of coefficients for the intercepts set attribute "merge" of `sintercept` to `FALSE`.

**Value**

an object from class `SubsetPM`

**Note**

This function may change.

**Author(s)**

Georgi N. Boshnakov

**Examples**

```r
## see examples for class "SubsetPM"
```
Media for four stocks since 2016-01-01

Data for four stocks since 2016-01-01.

Usage

data("four_stocks_since2016_01_01")

Format

A list with components "DELL","MSFT", "INTC", "IBM". Each component is a time series from class "xts" "zoo".

Details

Note: This dataset is temporary for use in testing, although it may appear in some examples. Eventually it may be renamed and/or replaced by other data.

Stock market data for Dell, Microsoft, Intel and IBM, from 2016-01-01 to 2020-04-17. The Dell data start from 2016-08-17. All data were downloaded from Yahoo Finance on 2020-04-18.

Source

https://finance.yahoo.com/

Examples

data(four_stocks_since2016_01_01)
DELL <- four_stocks_since2016_01_01$DELL
head(DELL)
tail(DELL)

dell <- pcts(DELL)

head(as_datetime(dell))
head(Pctime(dell))

## Weekends are totally absent from the data,
## so a Monday-Friday sub-cycle is created:
nSeasons(dell)
dell@cycle

## there are some NA's in the data, due to Bank holidays
Pctime(c(2624, 5), pcCycle(dell)) # "W2624 Fri"
as_datetime(Pctime(c(2624, 5), pcCycle(dell))) # "2020-04-10 UTC"
Fraser2017

Fraser2017  Fraser River at Hope, mean monthly flow

Description

Mean monthly flow (cms) of Fraser River From March 1912 to December 2017, recorded by Fraser River at Hope station.

Usage

data("Fraser2017")

Format

A time series (class "ts") with frequency 12, starting from January 1912 (the first two data values are NA) to December 2017.

Details

Dataset Fraser2017 is an extention of dataset "Fraser" in package "pear". The latter runs upto December 1990 (not the documented December 1991). At the time of writing this package "pear" is archived on CRAN, which is the main reason to include the dataset (with the added benefit of almost 30 years of additional data.

Source

https://wateroffice.ec.gc.ca/

Examples

data(Fraser2017)

fr <- window(Fraser2017, start = c(1912, 3), end = c(1990, 12))
## all.equal(as.numeric(fr), as.numeric(pear::Fraser)) # TRUE
## all.equal(tsp(fr), tsp(pear::fraser)) # TRUE
maxLag-methods  

Methods for function maxLag() in package 'pcts'

Description

Methods for function maxLag() in package 'pcts'.

Methods

signature(object = "PeriodicArmaFilter")

Examples

## non-periodic autocovariances
maxLag(autocovariances(AirPassengers))

## periodic
pcts_exdata() # creates ap, ap7to9, pcfr, pcfr2to4,
maxLag(autocovariances(ap, maxlag = 6))

## pcarma filter
m <- rbind(c(0.81, 0), c(0.4972376, 0.4972376))
ar_filt3 <- new("PeriodicBJFilter", coef = m, order = c(1,2))
arma_filt3 <- new("PeriodicArmaFilter", ar = ar_filt3)
maxLag(arma_filt3)

mC.ss

Create environment for mc-fitting

Description

Creates an environment for mc-fitting. These functions are transitory, hence the strange names.

Usage

mC.ss(spec, ...)

xx.ss(period, type.eigval, n.root, eigabs, eigsign, co_r, co_arg,
     init = NULL, len.block = NULL, mo.col, generators = NULL)
Arguments

- **spec**: a model, an object of class mcSpec.
- **period**: the number of seasons.
- **type.eigval**: types of the eigenvalues, a character vector with elements "r" or "cp", see Details.
- **n.root**: number of roots. Currently the dimension of the matrix is set to this.
- **eigabs**: The absolute values/moduli of the eigenvalues, numeric vector.
- **eigsign**: The signs/moduli of the eigenvalues.
- **co_r**: similar to eigabs but for the co parameters.
- **co_arg**: similar to eigsign but for the co parameters.
- **init**: initial values, see Details.
- **len.block**: lengths of Jordan blocks.
- **mo.col**: last non-zero column in the top of the matrix.
- **generators**: TODO: describe this argument.

Details

`mC.ss` takes the specification of the model as an object of class mcSpec and calls `xx.ss`. Basically, the value returned by these functions is an extended model specification together with an environment which can be used for fitting the model, exploring the results and trying various things. This may be used for getting better understanding of the model and the optimisation routines.

The result of both function is a list, containing several functions and an environment. The environment (element `env`) is the most important element since it allows access to everything in the model environment. The function elements of the list are simply a convenience.

Several functions in `env` are available for fitting the model. Currently these are `minim`, `minimBB` and `minimBBlu`. The first argument of all these functions is a time series to which the model is to be fitted. By default, a conditional likelihood is being optimised. To base the optimisation on conditional sum of squares, set argument `CONDLIK` to FALSE. The remaining arguments in a call to any of the above functions are passed on to the corresponding optimisation routine (whose help page should be consulted for details).

`minim` uses the core R function `optim`. `minimBB` and `minimBBlu` use `BBoptim` from package BB. They result is a list, as returned by the corresponding optimisation function with the optimal parameters in element `par`. The elements of this vector are named to help somewhat in its interpretation but complete information about the fitted model can be obtained from the environment.

Firstly, at the end of the optimisation, the optimal parameters and other information are stored in `env`. If the same call (maybe with modified instructions for the optimisation) is repeated, these parameters will be used as initial values for a new optimisation run. This may be useful, for example, if the previous run didn’t converge.

Secondly, properties of the fitted model and more useful representations can be obtained using functions in the environment or the convinience functions in the list returned by `xx.ss`.

`optpar2mcparam` converts a vector of parameters into the more familiar filter representation, where the i-th row contains the coefficients for the i-th season. This function takes one argument the
vector of parameters, e.g. the one returned by the fitting functions. It updates a number of variables in env, computes the filter representation of the model and stores it in wrkmodel. It returns NULL. This function may be used for exploratory purposes or to set new values for the parameters, e.g. to be used as starting values for a new optimisation run.
mtparam2optparam does the opposite. It converts the current model in env to a vector of parameter. This function does not have arguments.
mclik computes the value of the conditional likelihood for given parameters. Its first argument is a time series, the second is a vector of parameters and the third is a vector of innovations. Only the first argument is compulsory. If param is not supplied, the current parameters in env are used. Otherwise, they are updated with the new parameters and then used. The innovations default to the zero vector. mcss is similar but computes the conditional sum of squares.

**Argument** init can be used to provide initial values. If it is missing or NULL, random initial values are generated for the free parameters. init may also be a numeric vector suitable for the call optparam2mtparam(init), see above. This vector would typically come from a previous optimisation run.

init may also be a list with elements "eigabs", "eigsign", "co_r", "co_abs". These components have the same meaning as the corresponding arguments of xx.ss.

**TODO: more is needed here!**

**Value**

A list with the following components:

- fmcss a function to compute the sum of squares for a model.
- fparamvec a function to convert mc-parameters to optimisation parameters.
- fmtparam a function to convert optimisation parameters to mc-parameters.
- env an object of class environment

**Author(s)**

Georgi N. Boshnakov

**References**


**See Also**

- xx.ss which is called by mC.ss

**Examples**

```r
# test0 roots
spec.coz2 <- mcompanion::mcSpec(dim = 5, mo = 4, root1 = c(1,1), order = rep(2,4))
spec.coz2
xxcoz2a <- mC.ss(spec.coz2)
```
## test0 roots

```r
spec.coz4 <- mcompanion::mcSpec(dim = 5, mo = 4, root1 = c(1,1), order = rep(3,4))
xxcoz4a <- mC.ss(spec.coz4)
```

---

**Description**

Asymptotic covariance matrix of periodic mean.

**Usage**

```r
meanvarcheck(parmodel, n)
```

```r
meancovmat(parmodel, n, cor = FALSE, result = "var")
```

**Arguments**

- `parmodel`: a periodic model.
- `n`: number of observations (TODO: need clarification here).
- `cor`: if TRUE, return correlations
- `result`: if "var", return the diagonal of the covariance matrix, otherwise return the matrix.

**Details**

Computes asymptotic covariance or correlation matrix of the periodic means.

**Value**

- if `result = "var"` a matrix, otherwise a vector

**Author(s)**

Georgi N. Boshnakov

**See Also**

`parcovmatlist`
Examples

```r
x <- arima.sim(list(ar=0.9), n=1000)
proba1 <- fitPM(c(3,2,2,2), x)

meancovmat(proba1, 100)
meancovmat(proba1, 100, cor = TRUE)
meancovmat(proba1, 100, result = "")
meancovmat(proba1, 100, cor = TRUE, result = "")

meanvarcheck(proba1, 100)
```

---

**modelCycle**  
*Get the cycle of a periodic object*

**Description**

Get the cycle of a periodic object, a generic function.

**Usage**

```r
modelCycle(object)
```

```r
modelCycle(object, ... ) <- value
```

**Arguments**

- `object` an object.
- `value` the new value for the cycle, an object inheriting from "BasicCycle".
- `...` not used.

**Details**

`modelCycle` is essentially internal, for programming. The user level function to get the cycle of an object is `pcCycle`.

`modelCycle` returns the Cycle object (in the sense of package `pcts`), associated with `object`.

`modelCycle` is a generic function which makes it possible to associate a cycle with objects from a class, without inheriting from the cycle classes.

By definition, `NULL` represents the model cycle of objects from classes with no (inherited) method for `modelCycle`.

The default method of `modelCycle` returns `NULL`. The default method for its replacement version throws error.

**Value**

For `modelCycle`, an object inheriting from class "BasicCycle" or `NULL`;

"modelCycle<=" is used for the side effect of changing the cycle of `object`. 

---
Methods

signature(object = "ANY")
signature(object = "ModelCycleSpec")

Description

Class ModelCycleSpec.

Objects from the Class

Objects can be created by calls of the form new("ModelCycleSpec", ...).

Slots

modelCycle: Object of class "BasicCycle"

Methods

modelCycle signature(object = "ModelCycleSpec"): ...
modelCycle<- signature(object = "ModelCycleSpec"): ...

nCycles

Basic time information about periodic time series

Description

Basic time information about periodic time series.

Usage

nCycles(x, ...)
nTicks(x)
nVariables(x, ...)

Arguments

x an object from a periodic time series class.
... further arguments for methods.
Details

nTicks gives the number of time points, i.e. number of rows in the matrix representation.

nVariables gives the number of variables in the time series.

nCycles gives the number of cycles available in the data, e.g. number of years for monthly data. It always gives an integer number. Currently, if the result is not an integer an error is raised. **TODO:** There is a case to round up or give the number of full cycles available but this seems somewhat dangerous if done quietly. A good alternative is to provide argument for control of this.

Value

integer number

Author(s)

Georgi N. Boshnakov

Examples

```r
ap <- pcts(AirPassengers)
nVariables(ap)
nTicks(ap)
nCycles(ap)

monthplot(ap)
boxplot(ap)
```
num2pcpar

Methods

signature(object = "DayWeekCycle")
signature(object = "FiveDayWeekCycle")
signature(object = "MonthYearCycle")
signature(object = "PeriodicIntegratedArmaSpec")
signature(object = "QuarterYearCycle")
signature(object = "PeriodicMonicFilterSpec")
signature(object = "PeriodicInterceptSpec")
signature(object = "Cyclic")
signature(object = "BareCycle")
signature(object = "OpenCloseCycle")
signature(object = "Every30MinutesCycle")
signature(object = "PartialCycle")
signature(object = "VirtualPeriodicModel")

Author(s)

Georgi N. Boshnakov

Examples

ap <- pcts(AirPassengers)
nSeasons(ap) # 12
pcfr <- pcts(dataFranses1996)
nSeasons(pcfr) # 4

Description

Fit PAR model using sample autocorrelations.

Usage

num2pcpar(x, order, result = NULL, ...)

Arguments

x
time series, a numeric vector.
order
PAR order, a single number or a vector with one entry for each season.
result
what to return, the default is to return the full model, see Details.
... 
passed on to calc_peracf.
Details

Computes the periodic autocorrelations and fits a PAR model using the Periodic Levinson-Durbin algorithm.

The order is a vector of non-negative integers, specifying the autoregressive orders for each season. If order is a single number, then all seasons have that order.

mean controls centering in the computation of the autocorrelations. If mean is numeric, then subtract the supplied mean before computing the autocovariances. If mean is TRUE, the default, compute and subtract the sample periodic mean before computing the autocovariances. If mean is FALSE, do not centre the series, i.e. assume that the mean is zero.

If result is NULL, the default, returns the full model. If result = "coef", returns the PAR coefficients only (currently any value of result other than NULL has this effect).

Value

The coefficients of the fitted model or a list with components:

- mean: the mean, set as described in Details.
- coef: forward prediction coefficients.
- scale: standard deviations of the innovations.

Author(s)

Georgi N. Boshnakov

See Also

fitPM which uses num2pcpar for calculations

Examples

```r
## Not run:
simts1 <- matrix(rnorm(100), nrow = 4)
num2pcpar(simts1, order = c(3,2,2,2), period = 4 )
num2pcpar(simts1, order = c(3,2,1,2), period = 4 )
pdSafeParOrder(c(3,2,1,2))
pdSafeParOrder(c(3,2,2,1))
num2pcpar(simts1, order = c(3,2,2,1), period = 4 )
num2pcpar(simts1, order = pdSafeParOrder(c(3,2,2,1)), period = 4 )
num2pcpar(simts1, order = c(3,2,1,2), period = 4 )
num2pcpar(simts1, order = c(3,2,1,2), period = 4, mean = rep(0,4) )
num2pcpar(simts1, order = c(3,2,1,2), period = 4, mean = FALSE )
num2pcpar(simts1, order = c(3,2,1,2), period = 4, mean = FALSE )$coef@m -
    num2pcpar(simts1, order = c(3,2,1,2), period = 4 )$coef@m

## End(Not run)
```
parcovmatlist

Compute asymptotic covariance matrix for PAR model

Description

Compute asymptotic covariance matrix for PAR model

Usage

parcovmatlist(parmodel, n, cor = FALSE, result = "list")

Arguments

- `parmodel`: PAR model, object of class `parModel`
- `n`: length of the series or a vector with one element for each season.
- `cor`: If TRUE return correlation matrix.
- `result`: if "list", the default, return a list, if "Matrix" return a Matrix object, otherwise return an ordinary matrix, see Details.

Details

Uses eq. (3.3) in the reference.

If `result = "list"`, `parcovmatlist` returns a list whose s-th element is the covariance matrix of the PAR parameters for the s-th season. Otherwise, if `result = "Matrix"` it returns a block-diagonal matrix created by `.bdiag()` from package "Matrix". If `result = "matrix"` it returns an ordinary matrix (with the current implementation this is returned for any value other than "list" or "Matrix").

Value

a list, matrix or block-diagonal matrix, as described in Details

Author(s)

Georgi N. Boshnakov

References


See Also

`pcacfMat`, `pc.acf.parModel`
Examples

```r
x <- arima.sim(list(ar=0.9), n=1000)
proba1 <- fitPM(c(3,2,2,2), x)

parcovmatlist(proba1, 100)
parcovmatlist(proba1, 100, cor = TRUE)
sqrt(diag(parcovmatlist(proba1, 100, cor = TRUE)[[1]]))

meanvarcheck(proba1, 100)
```

PartialCycle-class  Class PartialCycle

Description

Class PartialCycle

Objects from the Class

Objects can be created by calls of the form `new("PartialCycle",...)

Partial cycles are often created implicitly when subsetting time series using `window()` with argument `seasons`, see the examples.

Slots

orig: the parent class of the partial cycle, an object inheriting from class "BasicCycle".

subindex: an integer vector specifying the seasons to include in the partial cycle.

Extends

Class "BasicCycle", directly.

Methods

`allSeasons` signature(x = "PartialCycle", abb = "logical"): ...

`allSeasons` signature(x = "PartialCycle", abb = "missing"): ...

`nSeasons` signature(object = "PartialCycle"): ...

`unitCycle` signature(x = "PartialCycle"): ...

`unitSeason` signature(x = "PartialCycle"): ...

See Also

BuiltinCycle
Examples

```r
dwc <- new("DayWeekCycle")
dwc
allSeasons(dwc)

## a five day week cycle
dwc5 <- new("PartialCycle", orig = dwc, subindex = 1:5)
dwc5
allSeasons(dwc5)

weekend <- new("PartialCycle", orig = dwc, subindex = 6:7)
weekend
allSeasons(weekend)

ap <- pcts(AirPassengers)

## take data for the summer months (in Northern hemisphere)
ap7to9 <- window(ap, seasons = 7:9)
## the above implicitly creates a partial cycle
ap7to9
allSeasons(ap7to9)
```

---

**PartialPeriodicAutocorrelations-class**

Class *PartialPeriodicAutocorrelations*

**Description**

Class *PartialPeriodicAutocorrelations*.

**Objects from the Class**

Objects can be created by calls of the form `new("PartialPeriodicAutocorrelations", ... , data)`.

**Slots**

- `modelCycle`: Object of class "BasicCycle" ~~
- `data`: Object of class "Lagged" ~~

**Extends**


**Methods**

`show` signature(object = "PartialPeriodicAutocorrelations"): ...
pc.filter

Applies a periodic ARMA filter to a time series

Description

Filter time series with a periodic arma filter. If whiten is FALSE (default) the function applies the given ARMA filter to eps (eps is often periodic white noise). If whiten is TRUE the function applies the “inverse filter” to x, effectively computing residuals.

Usage

pc.filter(model, x, eps, seasonof1st = 1, from = NA, whiten = FALSE, nmean = NULL, nintercept = NULL)

Arguments

- x: the time series to be filtered, a vector.
- eps: residuals, a vector or NULL.
- model: the model parameters, a list with components "phi", "theta", "p", "q", "period", "mean" and "intercept", see Details.
- seasonof1st: the season of the first observation (i.e., of x[1]).
- from: the index from which to start filtering.
- whiten: if TRUE use x as input and apply the inverse filter to produce eps ("whiten" x), if FALSE use eps as input and generate x ("colour" eps).
- nmean: a vector of means having the length of the series, see Details.
- nintercept: a vector of intercepts having the length of the series, see details.

Details

The model is specified by argument model, which is a list with the following components:

- phi: the autoregression parameters,
- theta: the moving average parameters,
- p: the autoregression orders, a single number or a vector with one element for each season,
- q: the moving average orders, a single number or a vector with one element for each season,
- period: number of seasons in a cycle,
- mean: means of the seasons,
- intercept: intercepts of the seasons.

The relation between x and eps is assumed to be the following. Let

\[ y_t = x_t - m u_t \]
be the mean corrected series, where $\mu_t$ is the mean, see below. The equation relating the mean corrected series, $y_t = x_t - \mu_t$, and $\epsilon$ is the following:

$$y_t = c_t + \sum_{i=1}^{p_t} \phi_t(i)y_{t-i} + \sum_{i=1}^{q_t} \theta_t(i)\epsilon_{t-i} + \epsilon_t$$

where $c_t$ is the intercept, $n\text{intercept}$. The inverse filter is obtained by writing this as an equation expressing $\epsilon_t$ through the remaining quantities.

If $\text{whiten} = \text{TRUE}$, \pc.filter uses the above formula to compute the filtered values of $x$ for $t=\text{from}, \ldots, n$, i.e. whitening the time series if $\epsilon$ is white noise. If $\text{whiten} = \text{FALSE}$, $\epsilon$ is computed, i.e. the inverse filter is applied on $x$ from $\epsilon$, i.e. “colouring” $x$. In both cases the first few values in $x$ and/or $\epsilon$ are used as initial values.

Essentially, the mean is subtracted from the series to obtain the mean-corrected series, say $y$. Then either $y$ is filtered to obtain $\epsilon$ or the inverse filter is applied to obtain $y$ from $\epsilon$, finally the mean is added back to $y$ and the result returned.

The mean is formed by $\text{model}\$\$\text{mean}$ and argument $\text{nmean}$. If $\text{model}\$\$\text{mean}$ is supplied it is recycled periodically to the length of the series $x$ and subtracted from $x$. If argument $\text{nmean}$ is supplied, it is subtracted from $x$. If both $\text{model}\$\$\text{mean}$ and $\text{nmean}$ are supplied their sum is subtracted from $x$.

The above gives a vector $y$, $y_t = x_t - \mu_t$, which is then filtered. If the mean is zero, $y_t = x_t$ in the formulas below.

Finally, the mean is added back, $x_t = y_t + \mu_t$, and the new $x$ is returned.

The above gives a vector $y$ which is used in the filtering. If the mean is zero, $y_t = x_t$ in the formulae below.

\pc.filter can be used to simulate \pc-arma series with the default value of \text{whiten=FALSE}. In this case $\epsilon$ is the input series and $y$ the output.

$$y_t = c_t + \sum_{i=1}^{p_t} \phi_t(i)y_{t-i} + \sum_{i=1}^{q_t} \theta_t(i)\epsilon_{t-i} + \epsilon_t$$

Then $\text{model}\$\$\text{mean}$ or $\text{nmean}$ are added to $y$ to form the output vector $x$.

Residuals corresponding to a series $y$ can be obtained by setting $\text{whiten=TRUE}$. In this case $y$ is the input series. The elements of the output vector $\epsilon$ are calculated by the formula:

$$\epsilon_t = -c_t - \sum_{i=1}^{q_t} \theta_t(i)\epsilon_{t-i} - \sum_{i=1}^{p_t} \phi_t(i)y_{t-i} + y_t$$

There is no need in this case to restore $x$ since $\epsilon$ is returned.

In both cases any necessary initial values are assumed to be already in the vectors. If \text{from} is not supplied it is chosen as the smallest $i$ such that for all $t \geq i, t-p[t]\geq0$ and $t-q[t]\geq0$, i.e. the filter will not require negative indices for $x$ or $\epsilon$.

\pc.filter calls the lower level function \pc.filter.xarma to do the computation.

**Value**

The filtered series: the modified $x$ if $\text{whiten=FALSE}$, the modified $\epsilon$ if $\text{whiten=TRUE}$. 

Level

1

Author(s)

Georgi N. Boshnakov

See Also

the lower level functions \texttt{pc.filter.xarma} which do the computations

\begin{verbatim}
pc.filter.xarma
\end{verbatim}

\textit{Filter time series with periodic arma filters}

Description

Filter time series with periodic arma filters with or options for periodic and non-periodic intercepts.

Usage

\begin{verbatim}
pc.filter.xarma(x, eps, phi, theta, period, p, q, n, from, 
    seasonof1st = 1, intercept = NULL, nintercept = NULL)
\end{verbatim}

Arguments

\begin{verbatim}
x \hspace{1cm} the time series to be filtered, a vector.
eps \hspace{1cm} the innovations, a vector.
phi \hspace{1cm} the autoregression parameters, a matrix.
theta \hspace{1cm} the moving average parameters, a matrix.
period \hspace{1cm} the period (number of seasons in a year).
p \hspace{1cm} the autoregression orders, recycled to period if length(p)=1.
q \hspace{1cm} the moving average orders, recycled to period if length(q)=1.
n \hspace{1cm} a positive integer, the time index of the last observation to be filtered.
from \hspace{1cm} a positive integer, the time index of the first observation to be filtered.
seasonof1st \hspace{1cm} a positive integer, the season of the time index of x[1], see Details.
intercept \hspace{1cm} the intercepts of the seasons, a vector of length \texttt{period}.
nintercept \hspace{1cm} intercepts, a vector of the same length as \texttt{x}.
\end{verbatim}
Details

`pc.filter.xarma` is somewhat lower level. The user level function is `pc.filter` which uses `pc.filter.xarma` to do the computations.

`pc.filter.xarma` filters the time series `x` by the following formula (for `t=from,...,n`):

\[ x_t = c_t + \sum_{i=1}^{p_t} \phi_t(i)x_{t-i} + \sum_{i=1}^{q_t} \theta_t(i)\varepsilon_{t-i} + \varepsilon_t, \]

where `c_t` is the overall intercept at time `t`, see below. Values of `x[t]` for `t` outside the range `from,n`, if any, are left unchanged. Values for `t<from` are used as initial values when needed.

Two intercepts are provided for convenience and some flexibility. The periodic intercept, `intercept`, is a vector of length `period`. It is replicated to length `n`, taking care to ensure that the first element of the resulting vector, say `a`, starts with `intercept[seasonof1st]`. `nintercept` can be an arbitrary vector of length `n`. It can be used to represent trend or contributions from covariates. `nintercept` is not necessarily periodic and argument `seasonof1st` does not affect its use. The overall intercept is obtained as the sum `c = a + nintercept`.

Usually `x` is a numeric vector but it can also be a matrix in which each column represents the data for one “year”. Also, the length of `x` is typically, but not necessarily, equal to `n`. It is prudent to ensure that `length(x) >= n` and this must be done if `x` is a matrix.

Argument `phi` is ignored if `p==0`, argument `theta` is ignored if `q==0`.

`pc.filter.xarma` is meant to be called by other functions whose task is to prepare the arguments with proper checks. It does not make much sense to repeat the checks in `pc.filter.xarma`. In particular, no check is made to ensure that `from` and `n` are correctly specified.

This is a low level function meant to be used with basic vectors and matrices. TODO: Implement in C/C++. In the current implementation, it accesses the elements of the arguments with straightforward indexing, so objects from classes may be used as well, provided that `x[t]`, `eps[t]`, `phi[t,i]`, `theta[t,i]`, as well as assignment to `x[t]`, are defined for scalar indices.

Value

Returns `x` with `x[from]` to `x[n]` filled with the filtered values and values outside the interval `from,...,n` left unchanged.

The mode of `x` is left unchanged. In particular, `x` may be a matrix with each row representing the data for a season. This is convenient since periodic time series are often more easily processed in this form.

Level

0 (base)

Author(s)

Georgi N. Boshnakov

See Also

`pc.filter`
pc.hat.h

function to compute estimates of the \( h \) weights

Description

The \( h \) coefficients are scaled cross-covariances between the time series and the innovations. This function computes estimates for \( h \) using as input the observed series, a series of estimated innovations, and an estimate of the variance of the innovations.

Usage

\[
\text{pc.hat.h}(x, \text{eps}, \text{maxlag}, \text{si2hat})
\]

Arguments

- \( x \) the observed time series \( x(t) \)
- \( \text{eps} \) a series of estimated innovations
- \( \text{maxlag} \) maximum lag
- \( \text{si2hat} \) estimate of the variance of the innovations

Details

If missing, the variance of the innovations is estimated from \( \text{eps} \).

Value

A matrix of the coefficient up to lag \( \text{maxlag} \) with one row for each season.

Author(s)

Georgi N. Boshnakov

References

pcacfMat

Description
Compute PAR autocovariance matrix

Usage
pc.acf.parModel(parmodel, maxlag = NULL)

pcacfMat(parmodel)

Arguments
parmodel PAR model, an object of class parModel.
maxlag maximum lag

Details
pc.acf.parModel returns the autocovariances of a PAR model in season-lag form with maximum lag equal to maxlag. If maxlag is larger than the available precomputed autocovariances, they missing ones are computed using the Yule-Walker relations. Note that pc.acf.parModel assumes that there are enough precomputed autocovariances to use the Yule-Walker recursions directly.

TODO: pc.acf.parModel is tied to the old classes since it accesses their slots. Could be used as a template to streamline the method for autocovariances for class "PeriodicAutocovariance". The season-lag form can be easily converted to other forms with the powerful indexing operator, see the examples and slMatrix-class.

pcacfMat is a convenience function for statistical inference. It creates a covariance matrix with dimension chosen automatically. This covariance matrix is such that the asymptotic covariance matrix of the estimated parameters can be obtained by dividing sub-blocks by innovation variances and inverting them. See, eq. (3.3) in the reference.

Value
for pcacfMat, a matrix
for pc.acf.parModel, an slMatrix

Author(s)
Georgi N. Boshnakov

References
See Also

\texttt{slMatrix-class}

Examples

```r
x <- arima.sim(list(ar = 0.9), n = 1000)
proba1 <- fitPM(c(3,2,2,2), x)

acfb <- pc.acf.parModel(proba1, maxlag = 8)
acfb[4:(-2), 4:(-2), type = "tt"]

pcacfMat(proba1)
```

\begin{tabular}{ll}
pcacf_pwn_var & Variances of sample periodic autocorrelations \\
\end{tabular}

Description

Computes the variances of sample periodic autocorrelations from periodic white noise.

Usage

```r
pcacf_pwn_var(nepoch, period, lag, season)
```

Arguments

- `lag` desired lags, a vector of positive integers.
- `season` desired seasons.
- `nepoch` number of epochs.
- `period` number of seasons.

Details

These are given by McLeod (1994), see the reference, eq. (4.3).

Value

A matrix whose (i,j)th entry contains the variance of the autocorrelation coefficient for season season[i] and lag lag[j].

Author(s)

Georgi N. Boshnakov
References


Examples

```r
pcacf_pwn_var(79, 12, 0:16, 1:12)
```

---

**Description**

Calculate partial periodic autocorrelations, forward and backward prediction coefficients and error variances using the periodic Levinson-Durbin algorithm.

**Usage**

```r
alg1(r, p)
```

**Arguments**

- `r`: periodic autocovariances, a matrix, see ‘Details’.
- `p`: autoregressive orders, numeric vector.

**Details**

`alg1(r, p)` calculates the partial periodic correlations from autocovariances `r` and autoregression orders `p`. The matrix `r` has the same format as that of the `r` slot of `pcAcvf` objects. The periodicity, `d`, is set equal to the number of rows in `r`. If the length of `p` is not equal to the periodicity, all autoregressive orders are set to the first element of `p`. This last feature is really meant to be used only with a scalar `p`.

The convention for the signs of the coefficients is the one from Boshnakov(1996) and is consistent with other R time series functions.

`pmax` below stands for the maximal element of `p`, i.e. the maximal AR order.

As in the non-periodic case, the periodic Levinson-Durbin algorithm fits recursively models of order 0, 1, ..., `pmax`. Namely, at step `i` the AR orders for all seasons are set to `i`. This is done in a way that correctly handles the case when not all elements of `p` are equal, see the references.

The essential quantities calculated by the periodic Levinson-Durbin algorithm are returned as matrices, whose `i`th rows contain values for season `i`. The complete details depend on the quantities, as described below.

The partial autocorrelations, the forward innovation variances and the backward innovation variances are returned as matrices with `d` rows and `1+pmax` columns, whose `j`-th columns contain the quantities for order `j-1` (partial autocorrelations, forward innovation variances and backward innovation variances, respectively). Note that the lag-0 partial autocorrelations are the autocovariances for lag 0, see the references for details.
The forward autoregression parameters are returned as a list whose \( j \)th element is a matrix containing the coefficients for order \( j \). Similarly for the backward autoregression parameters.

One often is interested in the model of order \( p \) only. Its coefficients are given by \( \text{af}[[p\text{max}]] \), while the innovation variances are in the last column of \( \text{fv} \).

### Value

A list with the following elements.

- `orders` autoregression orders
- `be` partial autocorrelations, a matrix with \( d \) rows
- `fv` forward innovation variances, a matrix with \( d \) rows
- `bv` backward innovation variances, a matrix with \( d \) rows
- `af` forward autoregression parameters, a list with one element for the parameters for each order.
- `ab` backward autoregression parameters, a list with one element for the parameters for each order.

### Note

The autoregression orders of the output are not necessarily the same as those specified in the call. There may be no PAR model with the requested orders, see the references.

### Author(s)

Georgi N. Boshnakov

### References


### See Also

`pdSafeParOrder`

### Examples

```r
r1 <- rbind(c(1, 0.81, 0.729), c(1, 0.90, 0.900))
algl(r1, 2)

## pc2 <- pcAcvf(init=r1)
## pc2a <- pcAcvf(init=r1, seasonnames=c("am", "pm"), periodunit="day")
```
# example of Lambert-Lacroix
data(ex1f)
pc3 <- slMatrix(period=2,maxlag=5,f=ex1f,type="tt")
res0p2 <- alg1(pc3[],c(0,2))
res1p2 <- alg1(pc3[],c(1,2))
res3p3 <- alg1(pc3[],c(3,3))

paramsys1 <- pcarma_param_system(pc3, NULL, NULL, 2, 0, 2)
t1 <- solve(paramsys1$A,paramsys1$b)

# this is from tests.r but I have lost t1
# set it to pc3 below
# note: t1 is not the t1 computed above and in other examples!
t1 <- pc3
t1
t1[]
alg1(t1[],c(1,1))
alg1(t1[],c(1,0))
alg1(t1[],c(0,1))
alg1(t1[],c(5,5))
alg1(t1[],c(2,2))
alg1(t1[],c(2,3))
alg1(t1[],c(3,3))
alg1(t1[],c(4,4))
alg1(t1[],c(5,5))

---

pcalg1util

Give partial periodic autocorrelations or other partial prediction quantities for a pcAcvf object.

Description

Give partial periodic autocorrelations or other partial prediction quantities for a pcAcvf object.

Usage

alg1util(x, s, at0 = 1)

Arguments

x an object of a class inheriting from pc.Model.WeaklyStat
s the required quantity, the name of one of the elements of the list returned by alg1.
at0 if not identical to "var", replace the elements of the result at lag zero with 1, see 'Details'.
Details

This function is a wrapper for \texttt{alg1()}. It calls \texttt{alg1}, to do the computations and returns the requested element as an object from class \texttt{slMatrix}. The model order is set to the maximal lag available in \texttt{x},

If \texttt{at0} is the character string "var", then the lag zero values in the result are set to the lag zero autocovariances, otherwise they are set to 1. This is mainly relevant for the periodic partial autocorrelations (s="be"), since the setting \texttt{at0="var"} ensures that they are in one to one correspondence with the autocovariances.

Value

the requested quantity as an object of type \texttt{slMatrix}

Author(s)

Georgi N. Boshnakov

References


See Also

\texttt{pdSafeParOrder, alg1}

Examples

\begin{verbatim}
  r1 <- rbind(c(1,0.81,0.729),c(1,0.90,0.900))
  # example of Lambert-Lacroix
  data(ex1f)
  pc3 <- slMatrix(period=2,maxlag=5,f=ex1f,type="tt")
  res0p2 <- alg1(pc3[,],c(0,2))
  res1p2 <- alg1(pc3[,],c(1,2))
  res3p3 <- alg1(pc3[,],c(3,3))
\end{verbatim}

Description

Apply a function periodically
Usage

pcApply(object, ...)

## S4 method for signature 'numeric'
pcApply(object, nseasons, FUN, ...)

## S4 method for signature 'matrix'
pcApply(object, nseasons, FUN, ...)

## S4 method for signature 'PeriodicTS'
pcApply(object, FUN, ...)

## S4 method for signature 'PeriodicMTS'
pcApply(object, FUN, ...)

Arguments

object an object for which periodic mean makes sense.
nseasons number of seasons.
FUN a function, as for apply.
... further arguments for FUN.

Details

For univariate periodic time series, pcApply applies FUN to the data for each season. For multivariate periodic time series, this is done for each variable.

The methods for "numeric" and "matrix" are equivalent to those for "PeriodicTS" and "PeriodicMTS", respectively. The difference is that the latter two don't need argument nseasons and take the names of the seasons from object.

Argument "..." is for further arguments to FUN. In particular, with many standard R functions argument na.rm = TRUE can be used to omit NA's, see the examples.

In the univariate case, when length(object) is an integer multiple of the number of seasons the periodic mean is equivalent to apply(matrix(object, nrow = nseasons), 1, FUN, ...).

Value

numeric or matrix for the methods described here, see section Details.

Methods

signature(object = "matrix")
signature(object = "numeric")
signature(object = "PeriodicMTS")
signature(object = "PeriodicTS")
Author(s)

Georgi N. Boshnakov

See Also

pcMean, apply

Examples

pcApply(pcts(presidents), mean, na.rm = TRUE)
pcMean(pcts(presidents), na.rm = TRUE) # same

pcApply(pcts(presidents), median, na.rm = TRUE)
pcApply(pcts(presidents), var, na.rm = TRUE)
pcApply(pcts(presidents), sd, na.rm = TRUE)

pcfr2to4 <- pcts(dataFranses1996)[2:4]
pcApply(pcfr2to4, median, na.rm = TRUE)
pcApply(pcfr2to4, sd, na.rm = TRUE)

pcAr.ss

Compute the sum of squares for a given PAR model

Description

Compute the sum of squares for a given PAR model.

Usage

pcAr.ss(x, model, eps = numeric(length(x)))

Arguments

x          time series, a numeric vector.
model      a model.
eps        residuals, defaults to a vector of zeroes. This may be used for models with
            moving average terms, for example.

Details

todo:

Value

a number

Author(s)

Georgi N. Boshnakov
**pcAR2acf**

*Compute periodic autocorrelations from PAR coefficients*

**Description**

Compute periodic autocorrelations from PAR coefficients. This effectively solves the inverse problem to that solved by the periodic Levinson-Durbin algorithm but does not use a recursion.

**Usage**

```r
pcAR2acf(coef, sigma2, p, maxlag = 10)
```

**Arguments**

- `coef`: PAR coefficients, a matrix, see Details.
- `sigma2`: innovations variances.
- `p`: PAR order.
- `maxlag`: How many lags to compute.

**Details**

`coef` is a matrix with the coefficients for season `i` in the `i`-th row. The coefficients start from lag 1. The first few autocorrelations are computed by solving a linear system, see the references. The rest are generated using the periodic Yule-Walker equations.

**Value**

A matrix, in which row `s` contains the acf’s for season `s` for lags 0, 1, ..., `maxlag` (in this order).

**Author(s)**

Georgi N. Boshnakov

**References**


**See Also**

`pcarma_acvf_lazy`, which does the main computation, but note that the coefficients for it start from lag zero.
Examples

```r
m <- rbind( c(0.81, 0), c(0.4972376, 0.4972376) )
si2 <- PeriodicVector(c(0.3439000, 0.1049724))

pcAR2acf(m)
pcAR2acf(m, si2)
pcAR2acf(m, si2, 2)
pcAR2acf(m, si2, 2, maxlag = 10)

# same using pcarma_acvf_lazy directly
m1 <- rbind( c(1, 0.81, 0), c(1, 0.4972376, 0.4972376) )

testphi <- slMatrix(init = m1)
myf <- pcarma_acvf_lazy(testphi, testtheta, si2, 2, 0, 2, maxlag = 10)
myf(1:2, 0:9)  # get a matrix of values

all(myf(1:2, 0:9) == pcAR2acf(m, si2, 2, maxlag = 9))  # TRUE
```

**pcarma_acvf2model**

Fit a PC-ARMA model to a periodic autocovariance function

---

**Description**

Fit a PC-ARMA model to a periodic autocovariance function.

**Usage**

```r
pcarma_acvf2model(acf, model, maxlag)
```

**Arguments**

- `acf` a periodic autocovariance function, an object of class `pcAcvf`.
- `model` a pc-arma model, an object of class `pcARMApq`. (todo: check!)
- `maxlag` not used. (todo: check!)

**Value**

- Describe the value returned If it is a LIST, use
  - `comp1` Description of `comp1`
  - `comp2` Description of `comp2`

**Author(s)**

Georgi N. Boshnakov
References


Examples

data(ex1f)
pc3 <- slMatrix(period=2,maxlag=5,f=ex1f,type="tt")
# pcarma_param_system(pc3, NULL, NULL, 2, 0, 2)
parsys <- pcarma_param_system(pc3, NULL, NULL, c(2,2), 0, 2)
param <- solve(parsys$A,parsys$b)

# res <- pcarma_acvf2model(pc3, list(p=c(1,2),q=0,period=2))
# res <- pcarma_acvf2model(pc3, list(p=c(1,2),q=0))
# res <- pcarma_acvf2model(pc3, list(p=c(1,2),period=2))
res <- pcarma_acvf2model(pc3, list(p=c(1,2)))

print(param)
print(res)

pcarma_solve

*Functions to compute various characteristics of a PCARMA model*

Description

Given a PCARMA model, create a function for computing autocovariances or coefficients of the corresponding infinite moving average representation or prepare the linear system whose solution provides the first few autocovariances of the model.

Usage

```r
pcarma_acvf_lazy(phi, theta, sigma2, p, q, period, maxlag = 100)
pcarma_h_lazy(phi, theta, p, q, period, maxlag = 200)
pcarma_acvf_system(phi, theta, sigma2, p, q, period)
pcarma_param_system(acf, h, sigma2, p, q, period)
pcarma_h(h, na = NA)
```

Arguments

- **phi**: the autoregression parameters, an object of class "slMatrix"
- **theta**: the moving average parameters, an object of class "slMatrix"
- **sigma2**: the innovation variances, an object of class "PeriodicVector" or a vector of size period, Details.
- **p**: the (maximal) autoregression order or the autoregression orders.
- **q**: the (maximal) moving average order or the moving average orders.
period  number of seasons in an epoch
maxlag  maximal lag for which the result is stored internally.
acf     the autocovariance function, an object of class pcAcvf, slMatrix, or similar
h       pcarma_param_system, h(t,k) is expected to return the coefficient \( h_{t,k} \). h is usually created by pcarma_h_lazy. For pcarma_h, a matrix of h(t,i) coefficients.
na      not used currently, controls what to do for large lags.

details

Compute acvf from parameters:

pcarma_acvf_lazy creates a function that will compute (on demand) values of the acf by a recursive formula. Computed values are stored internally for lags up to maxlag.

System for acvf from parameters:

pcarma_acvf_system forms a linear system for the calculation of autocovariances from the parameters of a pc-arma model. The argument theta is not used if \( q = 0 \) and phi is not used if \( p = 0 \).

System for parameters from acvf: pcarma_param_system takes the periodic autocovariances of a pc-arma model and computes a matrix and a vector representing the linear system whose solution provides the parameters of the model.
Scalar p specifies the same autoregression order for each season, similarly for q. p and q may be vectors of length period specifying the order for each season individually. In the latter case the solution of the system may not be a proper model or, if it is, its autocovariances may not be the ones used here! See the references for details.
The class of acf is not required to be one of those explicitly listed above, but it should understand their indexing conventions, similarly for sigma2.
For pure autoregression, \( q = 0 \), the arguments h and sigma2 are ignored. TODO: add sigma2 (if supplied) to the returned list?

Compute h from parameters:

pcarma_h_lazy: h(t,i) are the coefficients in infinite the moving average representation of the pc.arma model. The calculations use formula (4.4) from my paper (or elsewhere) with internal storage (in an slMatrix) of calculated results (for i<maxlag) and recursive calls to itself. So, it is not necessary to compute h(t,i) in any particular order.

Infinite MA coefficients(h):

pcarma_h Function to create a function for lazy computation of h(t,i) in pc.arma models
Takes a matrix of h(t,i) coefficients and returns a function that calculates h(t,i) from my paper xxx.
The returned value can be used in the same way as that of pcarma_h_lazy.

Value

for pcarma_acvf_lazy:
a function taking two arguments t and k such that for scalar t and k the call f(t,k) will return EX(t)X(t-k). If either of the arguments is a vector, then f(t,k) returns a matrix of size (length(t),length(k)) containing the respective autocovariances.
for pcarma_h_lazy:
a function, say $h$. In calls to $h$, if both arguments are scalars $h(t, i)$ returns $h_{t,i}$. If at least one of the arguments is a vector a matrix of values of $h$ is returned.

for pcarma_acvf_system:
a list with two components representing the linear system:
- **A** The $(p + 1)\text{period} \times (p + 1)\text{period}$ matrix of the system, an object of class "matrix".
- **b** The right-hand side of the system, a vector of length $(p + 1)\text{period}$, an object of class "vector".

$A^{-1}b$ can be used to get a vector of the autocovariances in the following order (d is the period, p is the maximal AR order):

$K(1, 0), \ldots, K(d, 0), K(1, 1), \ldots, K(d, 1), \ldots, K(1, p), \ldots, K(d, p)$.

for pcarma_param_system:
A list with components representing the linear system and the AR and MA orders:
- **A** The matrix of the system
- **b** The right-hand side of the system
- **p** The AR order
- **q** The MA order

$A^{-1}b$ will return a vector of the parameters of the pc arma model: all parameters for the first season, followed by all parameters for the second seasons and so on. For each season the parameters are in the following order (s is the current season, d is the period, $p[s]$ and $q[s]$ are the corresponding AR and MA orders):

$\sigma^2(s), \phi(s, 1), \ldots, \phi(s, p[s]), \theta(s, 1), \ldots, \theta(s, q[s])$.

for pcarma_h:
a function, say $h$. In calls to $h$, if both arguments are scalars $h(t, i)$ returns $h_{t,i}$. If at least one of the arguments is a vector a matrix of values of $h$ is returned. Analogous to pcarma_h_lazy.

Note

for pcarma_acvf_lazy: The recursion may become extremely slow for lags greater than maxlag. If large lags are likely to be needed the argument maxlag should be used to increase the internal storage. The default for maxlag currently is 100.

Author(s)
Georgi N. Boshnakov

References

See Also
pcarma_h, pcarma_param_system
## periodic acf of Lambert-Lacroix

data(ex1f)

```r
(pc3 <- slMatrix(period = 2, maxlag = 5, f = ex1f, type = "tt"))
```

## find the parameters

```r
s3 <- pcarma_param_system(pc3, NULL, NULL, 2, 0, 2)
coef3 <- solve(s3$A, s3$b)
pcarma_unvec(list(p = 2, q = 0, period = 2, param = coef3))
```

## actually, the model is PAR(1,2):

```r
s3a <- pcarma_param_system(pc3, NULL, NULL, c(1, 2), 0, 2)
coef3a <- solve(s3a$A, s3a$b)
pcarma_unvec(list(p = c(1,2), q = 0, period = 2, param = coef3a))
```

## prepare test parameters for a PAR(2) model with period=2.
## (rounded to 6 digits from the above example.

```r
m1 <- rbind(c(1, 0.81, 0), c(1, 0.4972376, 0.4972376) )
m2 <- rbind(c(1, 0, 0), c(1, 0, 0) )
testphi <- slMatrix(init = m1)
testtheta <- slMatrix(init = m2)
si2 <- PeriodicVector(c(0.3439000, 0.1049724)) # or si2 <- c(1,1)
```

## acf from parameters

```r
myf <- pcarma_acvf_lazy(testphi, testtheta, si2, 2, 0, 2, maxlag = 110)
myf(1,4) # compute a value
a1 <- myf(1:2,0:9) # get a matrix of values
```

## h from parameters

```r
h <- pcarma_h_lazy(testphi, testtheta, 2, 2, 2)
h(3, 2) # a scalar
h1 <- h(1:2, 1:4) # a matrix
```

## compute acvf from parameters

```r
( acfsys <- pcarma_acvf_system(testphi, testtheta, si2, 2, 0, 2) )
acfvect <- solve(acfsys$A, acfsys$b)
acf1 <- slMatrix(acfvect, period = 2)
```

## TODO: examples wirh q != 0

### Functions for work with a simple list specification of pcarma models

**Description**

Handle a simple list specification of pcarma models. Functions to convert to and from a representation appropriate for handing on to optimisation functions.
Usage

pcarma_prepare(model, type)
pcarma_unvec(model)
pcarma_tovec(model)

Arguments

model specification of a pcarma model, a list, see Details.
type not used.

Details

These functions work with a specification of a pcarma model as a list with components period, p, q, param, phi, theta and si2, see also section ‘Values’. The functions do not necessarily need or examine all these components.

Argument model is a list with components as accepted by pcarma_prepare. Details are below but the guiding rule is that there are sensible defaults for absent components.

pcarma_prepare gives a standard representation of model, in the sense that it ensures that the model has components period, p and q, such that p and q are vectors of length period. pcarma_prepare does not examine any other components of the model. (TODO: do the same for the innovation variance?)

If model$period is NULL, pcarma_prepare sets it to the length of the longer of model$p and model$q. If model$p is a scalar it is extended with rep(model$p, period). Missing or NULL model$p is equivalent to model$p = 0. model$q is processed analogously.

The net effect is that period, p and q will be set as expected as long as period is given or at least one of the other two is of length equal to the period. A warning is issued if period <= 1 (it is all too easy to give scalar values for p and q and forget to set the period, in which case period will be deduced to be one).

A number of functions (including pcarma_tovec and pcarma_unvec) dealing with the list representation of pcarma models start by calling pcarma_prepare to avoid the need for handling all possible cases.

pcarma_tovec returns a list with components p, q and param, where param is a numeric vector containing the pcarma parameters and the innovations variances and thus is suitable for optimisation functions. Notice that it is component param that is a vector. The reason that pcarma_tovec returns a list, is that the caller may need to do further work before calling a generic optimisation function. For example, it may wish to dop the variances from the vector.

pcarma_unvec(model) performs the inverse operation. It takes a list like that produced by pcarma_tovec and converts it to a detailed list containing the components of the model.

Value

for pcarma_unvec, a list with components:

p autoregressive orders, numeric vector
q moving average orders, numeric vector
si2 innovation variances
phi autoregressive parameters
theta moving average parameters

for `pcarma_tovec`, a list with components:
p autoregressive order
q moving average order
param parameters of the model, a numeric vector. TODO: give the order of the parameters in the vector!

for `pcarma_prepare`, a list as `pcarma_unvec`, see also Details.

Note
The specification and the functions were created ad hoc to get the computations going and are not always consistent with other parts of the package.

Author(s)
Georgi N. Boshnakov

---

**Description**

`pcCycle()` is a generic function with methods for creating, converting, modifying, and extracting cycle objects. `BuiltinCycle()` is a function to create cycle objects from the builtin cycle classes.

**Usage**

```r
pcCycle(x, type, ...) 
BuiltinCycle(n, coerce = FALSE, first = 1, stop = TRUE)
```

**Arguments**

- `x` an object, methods include numeric, character and cyclic objects, see Details.
- `type` class of the result. If equal to "auto", the default, the class is determined by the argument(s), otherwise should be the name of a cycle class.
- `...` further arguments for methods.
- `n` number of seasons, an integer.
- `coerce` if TRUE coerce the objects to a modifiable cycle class, currently "SimpleCycle".
- `first` which season is first for this object.
- `stop` if TRUE, the default, throw error if there is no builtin class with `n` seasons, otherwise create a "BareCycle" object.
Details

pcCycle serves as both a constructor and extractor of cycle objects. It is meant to just do the right thing, relieving the user from the burden of specifying a particular cycle class.

If \( x \) is numeric it constructs a cycle object with period \( x \) and additional properties as specified by the other arguments. If \( x \) is a character string, it is taken to be the name of one of the builtin cycles.

pcCycle can be used to create a modified version of a cycle object and/or convert it to another cycle type. This is done by providing a cycle object as argument \( x \), i.e. one inheriting from "BasicCycle".

If \( x \) inherits from "Cyclic", pcCycle returns its cycle component.

Argument type should be rarely needed, except maybe to conveniently force conversion of the builtin type to an ordinary type.

The descriptions of the individual methods in section Methods give some further specific details.

BuiltinCycle is a convenience function to create objects from builtin cycle classes by specifying the number of seasons. The builtin cycle classes are essentially fixed, except that which season is considered first can be changed using argument first. If other modifications are desired, convert the returned builtin cycle object to class "SimpleCycle". This can be done also in the call to BuiltinCycle() by specifying coerce = TRUE.

By default, BuiltinCycle throws an error if there is no builtin class with the requested number of seasons. Set argument stop to FALSE to create an object from class "BareCycle" instead (and it will be converted to "SimpleCycle" if coerce = TRUE). Argument stop is mainly for programming.

Value

for pcCycle, an object from one of the cycle classes;
for BuiltinCycle, an object from one of the builtin classes, coerced if requested.

Methods

signature(x = "numeric", type = "missing") creates a cycle object with period \( x \). If \( x \) is the only argument, a "BareCycle" object is created, otherwise the constructor of "SimpleCycle" is invoked with all arguments except type passed on to it.

signature(x = "character", type = "missing") creates an object from the class specified by \( x \). Currently this is equivalent to \( \text{new}(x, \ldots) \) but somewhat more portable. Future amendments may use a more suitable class for some combinations of the arguments. Also, if a class is renamed, a code will be inserted here to create an equivalent object.

signature(x = "numeric", type = "character")

signature(x = "character", type = "character") first call the method with type = "missing", then convert the result to class type.

signature(x = "Cyclic", type = "ANY") extracts the cycle component of \( x \) (\( x@\text{cycle} \)). Currently ignores the remaining arguments.

signature(x = "BasicCycle", type = "missing") convert an object from any cycle class to class "SimpleCycle". This is like as(x,"SimpleCycle") but can have further arguments.

signature(x = "BasicCycle", type = "character") convert an object from any cycle class to class type.
signature(x = "ts", type = "missing")
signature(x = "ts", type = "character") when x is of class "ts", extract the frequency and convert it to a cycle class. Just as for "ts", certain frequencies are taken to correspond to specific classes. While base R treats periodicities 4 and 12 specially, pcCycle extends this to all builtin classes in pcts. Argument type can be used to overwrite this default behaviour by requesting a specific class. In particular, type = "BareCycle" and type = "" cause the result to be "BareCycle".

signature(x = "PeriodicTimeSeries", type = "missing")
signature(x = "PeriodicTimeSeries", type = "character") extract the cycle part of an object inheriting from "PeriodicTimeSeries", currently "PeriodicTS" or "PeriodicMTS". Argument type can be used to force the result to be from a specific cycle class, as in the methods for "ts".

Author(s)
Georgi N. Boshnakov

See Also
allSeasons for further examples,
class BuiltinCycle for the available builtin classes and more examples

Examples
## pcCycle
pcCycle(4)
pcCycle(4, seasons = c("Spring", "Summer", "Autumn", "Winter"))

pcCycle("QuarterYearCycle")
BuiltinCycle(4) # same, recommended

pcCycle("QuarterYearCycle", type = "BareCycle")
pcCycle("QuarterYearCycle", type = "SimpleCycle")

## BuiltinCycle
BuiltinCycle(2) # "OpenCloseCycle"
BuiltinCycle(4) # "QuarterYearCycle"
BuiltinCycle(5) # five day week cycle
BuiltinCycle(7) # "DayWeekCycle"
BuiltinCycle(12) # "MonthYearCycle"
BuiltinCycle(48) # "Every30MinutesCycle"

## error, since there is no builtin cycle with 19 seasons:
## BuiltinCycle(19)

## use stop = FALSE to reate a default cycle in this case
BuiltinCycle(19, stop = FALSE)
BuiltinCycle(19, coerce = TRUE, stop = FALSE)
**pclsdf**  
*Fit PAR models using least squares*

**Description**

Fit PAR models using least squares. The model may contain intercepts and linear trends, seasonal or non-seasonal.

**Usage**

```r
pclsdf(x, d, lags = integer(0), sintercept = TRUE, sslope = FALSE,  
       intercept = FALSE, slope = FALSE, xreg, contrasts = NULL,  
       seasonof1st = NULL, coefonly = FALSE)
```

**Arguments**

- `x`: time series, a numeric vector
- `d`: period, an integer
- `lags`: an integer vector, typically `1:p`, where `p` is the order of the autoregression. The same lags are used for all seasons.
- `sintercept`: if TRUE include seasonal intercepts.
- `sslope`: if TRUE include seasonal linear trend.
- `intercept`: if TRUE include non-seasonal intercept.
- `slope`: if TRUE include non-seasonal linear trend.
- `xreg`: additional regressors, not used currently.
- `contrasts`: contrasts to use for the seasons factor variable.
- `seasonof1st`: season of the first observation in the time series, see Details.
- `coefonly`: if TRUE, return only the parameters of the fitted model, otherwise include also the object returned by `lm`.

**Details**

This function fits PAR models by the method of least squares. Seasonal intercepts are included by default. Non-seasonal intercepts are available, as well as seasonal and non-seasonal linear trend. Separate arguments are provided, so that any combination of seasonal and non-seasonal intercepts and slopes can be specified.

If `coefonly` is TRUE, `pclsdf` returns only the estimated parameters, otherwise it includes additional statistical information, see section Note for the current details.
pclsdf

Value

A list with the components listed below. Some components are present only if included in the model specification.

- **par**: the PAR coefficients, a matrix with a row for each season.
- **sintercept**: (if specified) seasonal intercepts, a numeric vector.
- **sigma2hat**: innovation variances.
- **formula.char**: the formula used in the call of `lm`, a character string.
- **fit**: (if `coefonly = FALSE`) the fitted object obtained from `lm`.

Note

Currently, `pclsdf` prepares a model formula according to the specification and calls `lm` to do the fitting. Component "fit" in the result (available when `coefonly = FALSE`) contains the raw fitted object returned by `lm`. Statistical inference based on this object would, in general, not be justified for correlated data.

**todo**: currently some of the parameters are returned only via the fitted object from `lm`.

Author(s)

Georgi N. Boshnakov

See Also

`pclsspi`, `pclspiar`

Examples

```r
## data(dataFranses1996)
cu <- pcts(dataFranses1996[, "CanadaUnemployment"])
cu <- window(cu, start = availStart(cu), end = availEnd(cu))

pclsdf(cu, 4, 1:2, sintercept = TRUE)
pclsdf(austres, 4, lags = 1:3)
pclsdf(austres, 4, lags = 1:3, sintercept = TRUE)
pclsdf(austres, 4, lags = 1:3, sintercept = TRUE, sslope = TRUE)

x <- rep(1:4,10)
pclsdf(x, 4, lags = 1:3, sintercept = TRUE, sslope = TRUE)
```

```r
## this is for the version when contrasts arg. was passed on directly to lm.
## tmp1 <- pclsdf(austres, 4, lags = 1, sintercept = FALSE, sslope = TRUE,
##               contrasts = list(Season = "contr.sum" ))
```
**Description**

Fit a periodically integrated autoregressive model.

**Usage**

```r
clspiar(x, d, p, icoef = NULL, parcoef = NULL, sintercept = FALSE, 
seasonof1st = 1, weights = TRUE, itol = 1e-07, maxniter = 1000)
```

**Arguments**

- `x`: time series.
- `d`: period.
- `p`: order of the model, a positive integer, see Details.
- `icoef`: initial values for the periodic integration coefficients.
- `parcoef`: not used currently.
- `sintercept`: if `TRUE` include seasonal intercepts.
- `seasonof1st`: season of the first observation.
- `weights`: if `TRUE`, use periodic weights in the nonlinear least squares, see Details.
- `itol`: threshold value for the stopping criterion.
- `maxniter`: maximum number of iterations.

**Details**

This function fits a periodically integrated autoregressive model using non-linear least squares. The order of integration is one and the order of the periodically correlated part is \( p - 1 \). So, \( p \) must be greater than or equal to one.

If `weights = TRUE` the non-linear optimisation is done with weights inversely proportional to the innovation variances for the seasons, otherwise the unweighted sum of squared residuals is minimised.

**Value**

A list currently containing the following elements:

- `icoef`: coefficients of the periodic integration filter.
- `parcoef`: coefficients of the PAR filter.
- `sintercept`: seasonal intercepts.
- `sigma2hat`: innovation variances.
Author(s)

Georgi N. Boshnakov

References


See Also

`pclsdf`, `test_piar`, `fitPM`

Examples

```r
## see also the examples for fitPM()

## see also the examples for fitPM()
t1 <- window(dataFranses1996[, "CanadaUnemployment"],
              start = c(1960, 1), end = c(1987, 4))
pclspiar(t1, 4, p = 1, sintercept = TRUE)
pclspiar(t1, 4, p = 2, sintercept = TRUE)
```

pcMean-methods

*Compute periodic mean*

### Description

Compute periodic mean, generic function.

### Usage

```r
pcMean(object, ...)
```

```r
## S4 method for signature 'numeric'
pcMean(object, nseasons, ...)
```

```r
## S4 method for signature 'matrix'
pcMean(object, nseasons, ...)
```

```r
## S4 method for signature 'PeriodicTS'
pcMean(object, ...)
```

```r
## S4 method for signature 'PeriodicMTS'
pcMean(object, ...)
```
Arguments

object: an object for which periodic mean makes sense.
nseasons: number of seasons.
...: further arguments for methods.

Details

For univariate periodic time series, `pcMean` computes the mean for each season and returns a named vector. For multivariate periodic time series, the result is a matrix with one column for each variable.

The methods for "numeric" and "matrix" are equivalent to those for "PeriodicTS" and "PeriodicMTS", respectively. The difference is that the latter two don't need argument `nseasons` and take the names of the seasons from `object`.

Argument `na.rm = TRUE` can be used to omit NA's.

In the univariate case, when `length(object)` is an integer multiple of the number of seasons the periodic mean is equivalent to computing the row means of `matrix(object, nrow = nseasons)`.

Value

numeric or matrix for the methods described here, see section Details.

Methods

signature(object = "matrix")
signature(object = "numeric")
signature(object = "PeriodicMTS")
signature(object = "PeriodicTS")
signature(object = "VirtualPeriodicArmaModel")

Author(s)

Georgi N. Boshnakov

See Also

`pcApply`

Examples

```r
pcMean(pcts(presidents))
pcMean(pcts(presidents), na.rm = TRUE)

pcMean(pcts(dataFranses1996)[2:5], na.rm = TRUE)

pcMean(1:20, nseasons = 4)
m <- matrix(1:20, nrow = 4)
all(apply(m, 1, mean) == pcMean(1:20, nseasons = 4)) # TRUE
```
pcPlot  

Plot periodic time series

Description

Plot periodic time series.

Usage

## S3 method for class 'PeriodicTimeSeries'
boxplot(x, ...)

## S3 method for class 'PeriodicTimeSeries'
monthplot(x, ylab = deparse(substitute(x)), base, ...)

Arguments

x  a periodic time series object.
...

... further arguments to be passed to the plotting function.

ylab  label for the y-axis, only used for univariate time series.

base  a function for use for computing reference lines.

Details

Functions for periodic/seasional plots and boxplots.

The S3 method for monthplot() just calls pcPlot().

Author(s)

Georgi N. Boshnakov

Examples

ap <- pcts(AirPassengers)
monthplot(ap)
boxplot(ap)

fr23 <- pcts(dataFranses1996[,2:3])
monthplot(fr23)
boxplot(fr23)
Test for periodicity

Usage

cpTest(x, nullmodel, nseasons, ...)

Arguments

x the object to be tested, e.g. a time series or a periodic acf

nullmodel specification of the test to be performed

nseasons number of seasons

... additional arguments to be passed on to methods

Details

This is a generic function which acts as a despatcher for various tests for periodicity and periodic correlation.
x is typically a time series but conceptually it is an object containing the statistics needed for carrying out the requested test. For example, x may be the periodic autocovariance function for tests based on sample autocorrelations and autocovariances.
The method with signature (x = "ANY", nullmodel = "character") may be considered as default for cpTest. The “real” default method simply prints an error message.

Value

a list containing the results of the requested test, see the individual methods for details

Methods

signature(x = "ANY", nullmodel = "character") Argument nullmodel specifies the test to be performed. It should be a single character string. If it is one of the strings recognised by this method, the test specified below is carried out. Otherwise nullmodel is taken to be the name of a function which is called with arguments (x,...).

Currently, the following character strings are recognised:

"wn" Box test for (non-periodic) white noise, simply calls Box.test.


signature(x = "slMatrix", nullmodel = "character") x here is the periodic autocovariance function. This method works similarly to the method for signature (x = "ANY", nullmodel = "character"), see its description.

Currently, the following character strings are recognised:
"pwn"  Ljung-Box test for periodic white noise.
"periodicity"  McLeod test for periodic correlation.
signature(x = "numeric", nullmodel = "character")
signature(x = "PeriodicTimeSeries", nullmodel = "character")

Note

TODO: critical values

Author(s)

Georgi N. Boshnakov

See Also
test_piar, pwn_McLeodLjungBox_test periodic_acf1_test

Examples

cu <- pcts(dataFranses1996[, "CanadaUnemployment"])
cu <- window(cu, start = availStart(cu), end = availEnd(cu))

test_piar(cu, 4, 1, sintercept = TRUE)
pTest(cu, "piar", 4, 1, sintercept = TRUE)

if(require(partsm)){
# same with LRurpar.test from partsm
LRurpar.test(cu, list(regular = c(0,0,0), seasonal = c(1,0), regvar = 0), p = 1)
}

Pctime

Pctime objects

Description

Class "Pctime" is an S3 class inheriting from the base R datetime class "POSIXct". It has methods for conversion between datetimes and the pcts cycle-season pairs, as well as convenience methods for a few other functions.

Usage

Pctime(x, cycle, ...)

as_Pctime(x, ...)

# S3 method for class 'Pctime'
x[i, j, drop = TRUE]
Pctime

```r
## S3 method for class 'Pctime'
x[[..., drop = TRUE]]

## S3 method for class 'Cyclic'
as_Pctime(x, ...)

## S3 method for class 'PeriodicTimeSeries'
as_Pctime(x, ...)
```

### Arguments

- **x**
  - for `Pctime`, numeric vector, matrix with two columns, or any object that is or can be converted to datetime. For the other functions see Details.
- **cycle**
  - a positive integer, cycle object, or missing.
- **i**
  - subscript
- **j**
  - no used
- **drop**
  - not used
- **...**
  - further argument for methods.

### Details

`Pctime` represents periodic times with cycle specification contained in attribute "cycle". It is basically datetime (inheriting from "POSIXct") with additional attribute(s).

For printing Pctime objects are shown as cycle-season pairs. To print in other formats, just convert them using `as_datetime` or other suitable function. Note though that some cycles in pcts do not have natural datetime representation. For them, Pctime sets it arbitrarily as the number of seconds from a origin.

The seasons in cycle-season pairs are numbered from one to the number of seasons. Names and abbreviations are used when available and this is the case for all builtin cycles and partial cycles obtained from them.

The cycles in cycle-season pairs are numbered from a starting point. For years, it is what is expected. For cycles representing weeks, week 1 is the first ISO week of 1970, so `c(1,1)` corresponds to 1969-12-29. For some other cycle classes `c(1,1)` also corresponds to the first time in the first ISO week of 1970.

Subsetting with "[" keeps the Pctime class, while "[[" returns a datetime object. Other standard functions work with Ptime objects, as well, including seq.

A common source of frustration is the accidental use of `as.Date` or `as_date`, instead of `as.POSIXlt` or `as_datetime`. These four are often equivalent, most notably for monthly, quarterly and daily observations but, in general, conversion to dates drops the fractional day part of a datetime.

The default time zone is UTC. Other time zones can be used since the calculations use standard datetime and date functions from base R and package lubridate (Grolemund and Wickham 2011), but currently this has not been tested.

### Value

- for Pctime, an object from S3 class Pctime
References

Examples
```r
## a bare bone date for four seasons
pct4 <- Pctime(c(2020, 2), pcCycle(4))
pct4

## quarterly cycle
Pctime("2020-04-01", BuiltinCycle(4))
pctQ <- Pctime(c(2020, 2), BuiltinCycle(4))  # same
pctQ

## day-in-week cycle
## c(1, 1) is the start of the first ISO week of 1970
weekW1S1 <- Pctime(c(1, 1), BuiltinCycle(7))  # W1 Mon
as_datetime(weekW1S1)

Pctime("1970-01-01", BuiltinCycle(7))  # W1 Thu
pctW1Th <- Pctime(c(1, 4), BuiltinCycle(7))  # same
pctW1Th

Pctime("2020-04-01", BuiltinCycle(7))
pctW2623Wed <- Pctime(c(2623, 3), BuiltinCycle(7))  # same
pctW2623Wed
as_datetime(pctW2623Wed)

## Monday-Friday week - a partial cycle derived from DayOfWeekCycle
BuiltinCycle(5)
pctMF <- Pctime("2020-04-03", BuiltinCycle(5))  # Fri
seq(pctMF, length.out = 10)  # note: Sat, Sun are skipped

Pctime("2020-04-04", BuiltinCycle(5))  # Sat, not in the cycle

## monthly cycle
Pctime("2020-04-01", BuiltinCycle(12))
pctY2020Apr <- Pctime(c(50, 4), BuiltinCycle(12))  # same
pctY2020Apr
as_datetime(pctY2020Apr)

## Pctime can hold a vector of times
ap <- pcts(AirPassengers)
aptime <- Pctime(ap)  # as_Pctime(ap)
aptime[1:12]  # keep Pctime class
aptime[1]

aptime[[1]]  # drop Pctime class

head(aptime)
```
pcts

Create objects from periodic time series classes

Description

Create objects from periodic time series classes.

Usage

pcts(x, nseasons, start, ..., keep = FALSE)

Arguments

x

a time series.

nseasons

number of seasons. This argument is ignored by some methods.

start

the starting time of the time series, can be a (cycle, season) pair or any object that can be converted to datetime.

keep

if TRUE and x is from class "ts", "mts", "zoo", or "zooreg", create a periodic object inheriting from that class.

... further arguments to be passed on to methods.

Details

pcts creates periodic time series objects inheriting from "PeriodicTimeSeries". The particular class depends on arguments x and, in some cases, keep. The idea is that in normal use the user does not care about the particular class.

There are also methods for as for conversion to and from the time series classes defined in package pcts.

Value

an object inheriting from "PeriodicTimeSeries", the defaults are "PeriodicTS" and "PeriodicMTS"

Methods

signature(x = "numeric", nseasons = "missing")

signature(x = "numeric", nseasons = "numeric")

signature(x = "numeric", nseasons = "BasicCycle") Creates an object of class "PeriodicTS", the native class for univariate periodic time series in package "pcts".

signature(x = "matrix", nseasons = "missing")
signature(x = "matrix", nseasons = "numeric")
signature(x = "matrix", nseasons = "BasicCycle") Creates an object of class "PeriodicMTS",
the native class for multivariate periodic time series in package "pcts".
signature(x = "data.frame", nseasons = "ANY") Currently this just calls pcts(as.data.frame(x), nseasons,...).
signature(x = "ts", nseasons = "missing")
signature(x = "ts", nseasons = "numeric") If keep = TRUE creates an object of class "PeriodicTS_ts",
otherwise the result is from "PeriodicTS". The number of seasons is taken from the "ts"
object.
signature(x = "mts", nseasons = "missing")
signature(x = "mts", nseasons = "numeric") If keep = TRUE creates an object of class "PeriodicMTS_ts",
otherwise the result is from "PeriodicMTS". The number of seasons is taken from the "ts"
object.
signature(x = "xtsORzoo", nseasons = "missing") x needs to a regular time series, possibly
with missing values for some times (technically, zoo::is.regular(x) should give TRUE).
For daily time series, the cycle is taken to be day of week or a subcycle of it, most commonly
Monday-Friday.
The implementation is incomplete but for daily data should work as described.

Author(s)

Georgi N. Boshnakov

See Also

PeriodicTS,

dataFranses1996 for further examples

Examples

## convert a ts object, no need for further info
pcts(AirPassengers, 12)

## numeric
v24 <- rnorm(24)
pcts(v24, nseasons = 4) # generic seasons
pcts(v24, nseasons = BuiltinCycle(4)) # Quarter/Year
ts1 <- pcts(v24, nseasons = BuiltinCycle(4), c(2006, 1)) # Quarter/Year with dates

## select subset of the seasons
window(ts1, seasons = 3:4)

## matrix, multivariate pcts
m24 <- matrix(v24, ncol = 3)
colnames(m24) <- c("A", "B", "C")
pcts(m24, nseasons = 4) # generic seasons
pcts(m24, nseasons = BuiltinCycle(4)) # Quarter/Year
mts1 <- pcts(m24, nseasons = BuiltinCycle(4), c(2006, 1)) # Quarter/Year with dates
mts1
## select subset of the seasons for mutivariate

```r
window(mts1, seasons = 3:4)
```

---

### Deprecated Functions in Package pcts

**Description**

These functions are marked for removal and are provided temporarily for compatibility with older versions of package pcts only. Use the recommended renamed or new functions instead.

**Details**

- `mCpar` has been renamed to `sim_parCoef`
- `sim_arAcf` has been renamed to `sim_parAcvf`

---

### pcts_exdata

**Periodic time series objects for examples**

**Description**

Periodic time series objects for examples and tests. These objects are from classes defined in package “pcts” and as a consequence are not suitable for access with `data()`.

**Usage**

```r
pcts_exdata(x, envir = parent.frame())
```

**Arguments**

- `x` a character vector giving the names of objects. If missing, all available objects will be created. Can also be `NA`. In that case no objects are created and the names of all available objects are returned.
- `envir` environment where the objects are put, the default is the environment of the caller.

**Details**

The requested objects are created and put in `envir`. Its default is the environment of the caller, which should be sufficient in most use cases.

The following objects are currently available: `ap, ap7to9, pcfr, pcfr2to4`. 
Value

if x is NA, the names of the available objects. Otherwise the function is called for the side effect of creating objects in envir and the return value (the names of the created objects) is usually discarded.

See Also

dataFranses1996

Examples

## the objects are created with something like:
ap <- pcts(AirPassengers)
ap7to9 <- window(ap, seasons = 7:9)

pcfr <- pcts(dataFranses1996)
pcfr2to4 <- pcfr[2:4]

Description

Compute a matrix of factors such that elementwise division of the periodic autocovariance matrix by it will give the periodic autocorrelations.

Usage

pc_sdfactor(sd, maxlag)

Arguments

sd standard deviations of the seasons numeric.
maxlag maximal lag, a number.

Value

a matrix of coefficients of size period x (maxlag+1). The length of sd is taken to be the period.

Author(s)

Georgi N. Boshnakov

See Also

autocorrelations
Examples

```r
# equivalent to data(Fraser, package = "pear")
Fraser <- window(Fraser2017, start = c(1912, 3), end = c(1990, 12))

logfraser <- window(pcts(log(Fraser)), start = c(1913, 1))
acvf1 <- autocovariances(logfraser, maxlag = 2)
fac <- pc_sdfactor(sqrt(acvf1[, 0]), 2)
fac[, 1:3]

acrf1 <- autocorrelations(logfraser, maxlag = 2)
all.equal(acvf1[, ], acrf1[, ] * fac) # TRUE
```

---

**pdSafeParOrder**

*Functions for some basic operations with seasons*

**Description**

Functions for some basic operations with seasons.

**Usage**

`pdSafeParOrder(p)`

**Arguments**

- `p` autoregression order, a vector of integers.

**Details**

`pdSafeParOrder(p)` modifies the periodic AR order specified by vector `p`. The modified order is such that the correspondence between autocovariances and partial autocorrelations is one-to-one, see the references for details.

**Value**

a vector of integers

**Author(s)**

Georgi N. Boshnakov

**References**


Examples

```r
pdSafeParOrder(c(0,2))
pdSafeParOrder(c(2,3))
```

---

**PeriodicArmaFilter-class**

*Class* "PeriodicArmaFilter"

---

**Description**

Class PeriodicArmaFilter.

**Objects from the Class**

Objects can be created by calls of the form `new("PeriodicArmaFilter",...,ar,ma,nseasons)`.

**Slots**

- `ar`: Object of class "PeriodicBJFilter" ~~
- `ma`: Object of class "PeriodicSPFilter" ~~

**Extends**

Class "VirtualArmaFilter", directly. Class "VirtualMonicFilter", by class "VirtualArmaFilter", distance 2.

**Methods**

No methods defined with class "PeriodicArmaFilter" in the signature.

---

**PeriodicArmaModel-class**

*Class* PeriodicArmaModel

---

**Description**

Class PeriodicArmaModel.

**Objects from the Class**

Objects can be created by calls of the form `new("PeriodicArmaModel",ar,ma,sigma2,...)`.
Slots

sigma2: Object of class "numeric" ~~
ar: Object of class "PeriodicArFilter" ~~
ma: Object of class "PeriodicMaFilter" ~~
center: Object of class "numeric" ~~
intercept: Object of class "numeric" ~~

Extends


Methods

autocovariances signature(x = "PeriodicArmaModel"): ...
Class PeriodicArModel

Description

Class PeriodicArModel.

Objects from the Class

Objects can be created by calls of the form `new("PeriodicArModel", ar, ma, sigma2, ...)`. 

Slots

- sigma2: Object of class "numeric"
- ar: Object of class "PeriodicArFilter"
- ma: Object of class "PeriodicMaFilter"
- center: Object of class "numeric"
- intercept: Object of class "numeric"

Extends


Methods

- `autocovariances` signature(x = "PeriodicArModel"): ...
- `fitPM` signature(x = "ANY", model = "PeriodicArModel"): ...

Create objects from class PeriodicArModel

Description

Create objects from class PeriodicArModel

Usage

`PeriodicArModel(object, ...)`
Arguments

- **object**: an object, can have one of a number of classes.
- ... further arguments for methods.

Details

PeriodicArModel creates objects from class PeriodicArModel. This is a generic function with despatch methods on the first argument.

Value

- an object from class "PeriodicArModel"

Methods

- `signature(object = "matrix")"object" gives the coefficients, one row per season.
- `signature(object = "numeric")"object" gives the model order. Its length is taken to be the number of seasons. The coefficients are set to NA.
- `signature(object = "PeriodicMonicFilterSpec")`
- `signature(object = "VirtualPeriodicArmaModel")`
- `signature(object = "PeriodicMonicFilterSpec")`
- `signature(object = "VirtualPeriodicArmaModel")`

<table>
<thead>
<tr>
<th>Class PeriodicAutocorrelations</th>
</tr>
</thead>
</table>

Description

Class PeriodicAutocorrelations.

Objects from the Class

Objects can be created by calls of the form `new("PeriodicAutocorrelations",...,data)`.

Slots

- `modelCycle`: Object of class "BasicCycle"
- `data`: Object of class "Lagged"

Extends

Methods

plot signature(x = "PeriodicAutocorrelations", y = "missing"): ...
PeriodicAutocovariances-class

Class PeriodicAutocovariances

Description

Class PeriodicAutocovariances.

Objects from the Class

Objects can be created by calls of the form new("PeriodicAutocovariances",...,data).

Slots

modelCycle: Object of class "BasicCycle" ~~
data: Object of class "Lagged" ~~

Extends


Methods

autocorrelations signature(x = "PeriodicAutocovariances",maxlag = "ANY",lag_0 = "missing"): ...

partialAutocorrelations signature(x = "PeriodicAutocovariances",maxlag = "ANY",lag_0 = "missing"): ...
PeriodicAutocovarianceSpec-class

Class PeriodicAutocovarianceSpec

Description

Class PeriodicAutocovarianceSpec.

Objects from the Class

Objects can be created by calls of the form new("PeriodicAutocovarianceSpec", ...).

Slots

pmatrix: Object of class "ANY" ~

Methods

No methods defined with class "PeriodicAutocovarianceSpec" in the signature.

PeriodicBJFilter-class

Class PeriodicBJFilter

Description

A class for filters following the Box-Jenkins sign convention

Objects from the Class

Objects can be created by calls of the form new("PeriodicBJFilter", coef, order, ...).

Slots

coef: Object of class "matrix" ~

order: Object of class "numeric" ~

Extends

Methods

filterCoef  signature(object = "PeriodicBJFilter", convention = "character"): ...
coerce signature(from = "matrix", to = "PeriodicBJFilter"): ...
coerce signature(from = "PeriodicBJFilter", to = "PeriodicSPFilter"): ...
coerce signature(from = "PeriodicSPFilter", to = "PeriodicBJFilter"): ...
filterPoly signature(object = "PeriodicBJFilter"): ...
filterPolyCoef signature(object = "PeriodicBJFilter"): ...
show signature(object = "PeriodicBJFilter"): ...

Author(s)

Georgi N. Boshnakov

See Also

PeriodicSPFilter

Examples

## a toy filter of order c(3, 3, 3, 3) and 4 seasons
co <- matrix(c(1, 1, 0,
               2, 2, 2,
               3, 0, 0,
               4, 4, 4), nrow = 4, ncol = 3)

## these are equivalent:
bj1 <- new("PeriodicBJFilter", coef = co)
bj1b <- new("PeriodicBJFilter", coef = co, order = 3)
bj1c <- new("PeriodicBJFilter", coef = co, order = c(3, 3, 3, 3))
identical(bj1b, bj1c) # TRUE
identical(bj1, bj1b) # FALSE but only because classbj1@order is "integer"

## a more refined spec. for the order:
show( new("PeriodicBJFilter", coef = co, order = c(2, 3, 1, 3)) )

## as()
show( as(co, "PeriodicBJFilter") )
show( as(co, "PeriodicSPFilter") )

## change the sign convention:
spl <- as(bj1, "PeriodicSPFilter")

## bj1 and spl represent the same filter
filterPolyCoef(bj1)
filterPolyCoef(spl)

identical(filterPolyCoef(bj1), filterPolyCoef(spl)) # TRUE
PeriodicFilterModel-class

Class PeriodicFilterModel

Description
Class PeriodicFilterModel.

Objects from the Class
Objects can be created by calls of the form new("PeriodicFilterModel", pcmean, pintercept, ...).

Slots
center: Object of class "numeric" ~
intercept: Object of class "numeric" ~
sigma2: Object of class "numeric" ~
ar: Object of class "PeriodicArFilter" ~
ma: Object of class "PeriodicMaFilter" ~

Extends

PeriodicIntegratedArmaSpec-class

Class PeriodicIntegratedArmaSpec

Description
Class PeriodicIntegratedArmaSpec.

Objects from the Class
Objects can be created by calls of the form new("PeriodicIntegratedArmaSpec", ...).

Slots
pcmodel: Object of class "PeriodicArmaModel" ~
Methods

\texttt{sigmaSq} signature(object = "PeriodicIntegratedArmaSpec"): ...

\begin{verbatim}
PeriodicInterceptSpec-class

Class PeriodicInterceptSpec

Description

Class PeriodicInterceptSpec.

Objects from the Class

Objects can be created by calls of the form \texttt{new("PeriodicInterceptSpec",...).}

Slots

center: Object of class "numeric" ~~
intercept: Object of class "numeric" ~~
sigma2: Object of class "numeric" ~~
modelCycle: Object of class "BasicCycle" ~~

Extends

Class "numLike", by class "numeric", distance 2. Class "number", by class "numeric", distance 2.
Class "atomicVector", by class "numeric", distance 2.

Methods

No methods defined with class "PeriodicInterceptSpec" in the signature.

\texttt{sigmaSq} signature(object = "PeriodicInterceptSpec"): ...
\texttt{allSeasons} signature(x = "PeriodicInterceptSpec", abb = "ANY"): ...
\texttt{initialize} signature(.Object = "PeriodicInterceptSpec"): ...
\texttt{nSeasons} signature(object = "PeriodicInterceptSpec"): ...
\texttt{show} signature(object = "PeriodicInterceptSpec"): ...
Class PeriodicMaModel

Description

Class PeriodicMaModel.

Objects from the Class

Objects can be created by calls of the form new("PeriodicMaModel",ar,ma,sigma2,...).

Slots

sigma2: Object of class "numeric"

ar: Object of class "PeriodicArFilter"

ma: Object of class "PeriodicMaFilter"

center: Object of class "numeric"

intercept: Object of class "numeric"

Extends


Methods

No methods defined with class "PeriodicMaModel" in the signature.

Class PeriodicMTS

Description

Class "PeriodicMTS" is the main class for multivariate periodic time series in package "pcts".

Objects from the Class

Objects can be created by calls of the form new("PeriodicMTS",...) but it is recommended to use the function pcts in most cases.
Slots

.Data: Object of class "matrix" ~~

cycle: Object of class "BasicCycle" ~~

cpstart: Object of class "ANY" ~~

Extends


Methods

$ signature(x = "PeriodicMTS"): ...

[ signature(x = "PeriodicMTS", i = "ANY", j = "missing", drop = "ANY"): ...

[ signature(x = "PeriodicMTS", i = "missing", j = "missing", drop = "ANY"): ...

[[ signature(x = "PeriodicMTS", i = "ANY"): ...

coerce signature(from = "mts", to = "PeriodicMTS"): ...

coerce signature(from = "PeriodicMTS", to = "ts"): ...

coerce signature(from = "ts", to = "PeriodicMTS"): ...

plot signature(x = "PeriodicMTS", y = "missing"): ...

show signature(object = "PeriodicMTS"): ...

summary signature(object = "PeriodicMTS"): ...

See Also

pcts which is the recommended way to create periodic time series,

class PeriodicTS for the univariate case,

dataFranses1996 and pcts-package for examples

Examples

pcfr <- pcts(dataFranses1996)
colnames(pcfr)[4] # "GermanyGNP"

## extracting single time series as univariate
class(pcfr[[4]]) # "PeriodicTS"
identical(pcfr[[4]], pcfr$GermanyGNP) # TRUE
identical(pcfr[[4]], pcfr[["GermanyGNP"]]) # TRUE
plot(pcfr[[4]])

## ... and as multivariate
pcfr[4] # "PeriodicMTS"
plot(pcfr[4])

## extracting more than one time series
plot(pcfr[2:4])
summary(pcfr[2:4])

pcfr2 <- pcfr[[2]]
plot(pcfr2)

---

**PeriodicMTS_ts-class**  
**Class** "PeriodicMTS_ts"

**Description**

Class "PeriodicMTS_ts" is a periodic class holding multivariate "ts" objects.

**Objects from the Class**

Objects can be created by calls of the form `new("PeriodicMTS_ts", x,...)`.

**Slots**

- `.Data`: Object of class "vector" ~~
- `cycle`: Object of class "BasicCycle" ~~
- `pcstart`: Object of class "ANY" ~~
- `tsp`: Object of class "numeric" ~~
- `.S3Class`: Object of class "character" ~~

**Extends**


**Methods**

- `coerce` signature(from = "ts", to = "PeriodicMTS_ts"): ...
- `initialize` signature(.Object = "PeriodicMTS_ts"): ...
PeriodicMTS_zooreg-class

Description
Class "PeriodicMTS_zooreg" is a periodic class holding multivariate "zooreg" objects.

Objects from the Class
Objects can be created by calls of the form new("PeriodicMTS_zooreg",...).

Slots
- cycle: Object of class "BasicCycle"
- .S3Class: Object of class "character"
- pcstart: Object of class "ANY"

Extends

Methods
No methods defined with class "PeriodicMTS_zooreg" in the signature.

PeriodicSPFilter-class

Description
A class for filters following the signal processing sign convention.

Objects from the Class
Objects can be created by calls of the form new("PeriodicSPFilter",coef,order,...).

Slots
- coef: Object of class "matrix"
- order: Object of class "numeric"
Extends


Methods

filterCoef signature(object = "PeriodicSPFilter", convention = "character"): ...

Author(s)

Georgi N. Boshnakov

See Also

PeriodicBJFilter

Examples

## see "PeriodicBJFilter-class" for examples

---

## PeriodicTimeSeries-class

**Class PeriodicTimeSeries**

**Description**

Class PeriodicTimeSeries.

**Objects from the Class**

A virtual Class: No objects may be created from it.

**Slots**

cycle: Object of class "BasicCycle".
pcstart: Object of class "ANY".

**Extends**

Class "Cyclic", directly.

**Methods**

pcTest signature(x = "PeriodicTimeSeries", nullmodel = "character"): ...
head signature(x = "PeriodicTimeSeries"): ...
pcCycle signature(x = "PeriodicTimeSeries", type = "ANY"): ...
tail signature(x = "PeriodicTimeSeries"): ...
Description

Class "PeriodicTS" is the main class for univariate periodic time series in package "pcts".

Objects from the Class

Objects can be created by calls of the form new("PeriodicTS", ...).

Slots

.Data: Object of class "numeric" ~~
cycle: Object of class "BasicCycle" ~~
pcstart: Object of class "ANY" ~~

Extends


Methods

coerce signature(from = "mts", to = "PeriodicTS"): ...
coerce signature(from = "PeriodicTS", to = "ts"): ...
coerce signature(from = "ts", to = "PeriodicTS"): ...
plot signature(x = "PeriodicTS", y = "missing"): ...
show signature(object = "PeriodicTS"): ...
summary signature(object = "PeriodicTS"): ...
Class "PeriodicTS_ts" is a periodic class holding "ts" objects.

Objects from the Class

Objects can be created by calls of the form new("PeriodicTS_zooreg",...).

Slots

- .Data: Object of class "vector"
- cycle: Object of class "BasicCycle"
- tsp: Object of class "numeric"
- .S3Class: Object of class "character"
- pcstart: Object of class "ANY"

Extends


Methods

- coerce signature(from = "ts", to = "PeriodicTS_ts"): ...
- initialize signature(.Object = "PeriodicTS_ts"): ...

Class "PeriodicTS_zooreg" is a periodic class holding "zooreg" objects.

Objects from the Class

Objects can be created by calls of the form new("PeriodicTS_zooreg",...).
PeriodicVector-class

Slots

cycle: Object of class "BasicCycle" ~~
.S3Class: Object of class "character" ~~
pcstart: Object of class "ANY" ~~

Extends

Class "PeriodicTimeSeries", directly. Class "ts", directly. Class "Cyclic", by class "Periodic-
TimeSeries", distance 2. Class "structure", by class "ts", distance 2. Class "oldClass", by class
"ts", distance 2. Class "vector", by class "ts", distance 3, with explicit coerce.

Methods

No methods defined with class "PeriodicTS_zooreg" in the signature.

See Also

classes PeriodicTS and PeriodicMTS

Description

Objects and methods for class PeriodicVector.

Usage

PeriodicVector(x, period = length(x))

Arguments

x the values for indices from 1 to period, numeric.
period the period, defaults to length(x).

Details

A $p$-periodic vector, $X$, is such that $X_{i+pk} = X_i$ for any integers $i, k$.

Class PeriodicVector stores the values of $X_1, \ldots, X_p$ and provides indexing methods for extract-
ing and setting its elements.

Value

an object from class "PeriodicVector"
Objects from the Class

Objects can be created by calls of the form `new("PeriodicVector",...)` or more conveniently by using `"PeriodicVector()"`.

Slots

- `.Data`: Object of class "numeric"
- `period`: Object of class "numeric"

Extends


Methods

"PeriodicVector" methods are defined for "[" and "[<-". Arithmetic operations just inherit the recycling rules from "numeric".

```r
[ signature(x = "PeriodicVector", i = "ANY", j = "ANY", drop = "ANY"): ...
[ signature(x = "PeriodicVector", i = "ANY", j = "missing", drop = "ANY"): ...
[ signature(x = "PeriodicVector", i = "missing", j = "ANY", drop = "ANY"): ...
[ signature(x = "PeriodicVector", i = "missing", j = "missing", drop = "ANY"): ...
[< signature(x = "PeriodicVector", i = "ANY", j = "ANY", value = "ANY"): ...
[< signature(x = "PeriodicVector", i = "missing", j = "ANY", value = "ANY"): ...
```

Author(s)

Georgi N. Boshnakov

See Also

`PeriodicVector`

Examples

```r
PeriodicVector(1:4, period = 4)
PeriodicVector(1:4) ## same
new("PeriodicVector", 1:4, period = 4)

## if period is given but x is missing, the vector is filled with NA's
PeriodicVector(period = 4)

## this throws error, since length(x) != period:
##   PeriodicVector(1:3, period = 4)
```
## extract
x <- PeriodicVector(1:4)
x[3:12]
x[c(3, 7, 11, 15)]

# any indices in (-Inf, Inf) work
x[0]
x[-3:0]

## "[<-" works on the underling vector
x[1] <- 11; x

## modulo indexing works also in assignments:
x[5] <- 21; x

## empty index returns the underlying vector
x[]

## the recycling rule applies on assignment
x[] <- 9; x
x[] <- 1:2; x

## this gives warning, as for numeric vectors
##     x[] <- 8:1
## compare:
##     x <- 1:4
##     x[] <- 8:1

## arithmetic works as usual:
2 * x
x + 1:4
## x + 1:3 # warning - '... a multiple ...'

---

**periodic_acf1_test**  
*McLeod's test for periodic autocorrelation*

### Description
Performs McLeod's test for periodic autocorrelation.

### Usage

```
periodic_acf1_test(acf, nepochs)
```

### Arguments

- **acf**: sample periodic autocorrelation function
- **nepochs**: the number of epochs used to get the acf
Details
The test statistic is a scaled sum of squares of lag 1 sample periodic autocorrelation coefficients, see McLeod (1993), eq. (5). The distribution is approximately chi-square under the null hypothesis of no periodic autocorrelation.

Value
A list containing the following components:
- statistic: the value of the test statistic.
- pvalue: the p-value associated with the test statistic.

Author(s)
Georgi N. Boshnakov

References

permean2intercept

Convert between periodic centering and intercepts

Description
Convert a periodic mean to periodic intercept and vice versa.

Usage
permean2intercept(mean, coef, order, nseasons = nrow(coef))

intercept2permean(intercept, coef, order, nseasons = nrow(coef))

Arguments
- mean: periodic mean, numeric.
- coef: PAR coefficients, matrix.
- order: PAR order, vector of positive integers.
- nseasons: number of seasons, a.k.a. period.
- intercept: periodic intercepts, numeric.
Details

A PAR model can be written in mean corrected or intercept form. `permean2intercept` calculates the intercepts from the means, while `intercept2permean` does the inverse (means from intercepts).

No check is made for periodic stationarity of the model. Converting from mean corrected to intercept form always succeeds and in fact the means do not need to be means. In the opposite direction there may be problems due to unit roots and similar features.

Value

a numeric vector

Author(s)

Georgi N. Boshnakov

Examples

```r
mu <- c(1, 2)
pm1 <- PeriodicArModel(matrix(c(0.5, 0.5), nrow = 2), order = rep(1, 2), sigma2 = 1, mean = mu)
cc <- permean2intercept(mu, pm1@ar@coef, c(1,1))
cc
intercept2permean(cc, pm1@ar@coef, c(1,1))

d <- 4
mu <- 1:d
co <- rep(0.5, d)
pm1 <- PeriodicArModel(matrix(co, nrow = d), order = rep(1, d), sigma2 = 1, mean = mu)
cc <- permean2intercept(mu, pm1@ar@coef, order = rep(1, d))
cc
intercept2permean(cc, pm1@ar@coef, order = rep(1, d))
```

---

`permodelmf` | *Compute the multi-companion form of a per model*

Description

Compute the multi-companion form of a per model.

Usage

`permodelmf(permodel, update = TRUE)`
Convert PIAR coefficients to PAR coefficients

pi1ar2par(picoef, parcoef)

Arguments

picoef coefficients of the periodic integration filter, a numeric vector or matrix, see Details.
parcoef coefficients of the periodically correlated part of the model.
Details

pi2par converts PIAR(1) model coefficients specified as a set of coefficients corresponding to a periodic unit root and PAR coefficients to coefficients for a single filter.

pi2par does the same but admits higher order periodic integration.

picoef is a matrix, specifying one or more first order periodic unit root filters. Each column contains the coefficients of one filter. If there is only one filter, its coefficients can be given as a numeric vector.

The filters are applied from right to left, in the sense that first the PAR filter is applied to the time series, then the filter specified by the last column and so on.

Note that unlike the stationary case, in general, this is not equivalent to multiplication of the corresponding polynomials. This is rather different from the stationary case, where the analogous operation boils down just to multiplying the corresponding polynomials.

Value

a matrix, whose i-th row contains the coefficients for the i-th season.

Author(s)

Georgi N. Boshnakov

Examples

```r
## Lina's example
parcoef <- rbind(c(0.5, -0.06), c(0.6, -0.08),
                 c(0.7, -0.1), c(0.2, 0.15))
picoef1 <- c(0.8, 1.25, 2, 0.5)
parcoef2 <- pi2par(picoef1, parcoef)

picoef2 <- c(4, 0.25, 5, 0.2)
coefper212 <- pi2par(picoef2, parcoef2)
```
**Slots**

- piorder: Object of class "numeric"
- picoef: Object of class "matrix"
- pcmmodel: Object of class "PeriodicArmaModel"

**Extends**

Class "VirtualPeriodicFilterModel", directly. Class "PeriodicIntegratedArmaSpec", directly.

**Methods**

No methods defined with class "PiPeriodicArmaModel" in the signature.

---

**PiPeriodicArModel-class**

*Class PiPeriodicArModel*

---

**Description**

Class PiPeriodicArModel.

**Objects from the Class**

Objects can be created by calls of the form `new("PiPeriodicArModel",...)`.

**Slots**

- piorder: Object of class "numeric"
- picoef: Object of class "matrix"
- pcmmodel: Object of class "PeriodicArmaModel"

**Extends**


**Methods**

`fitPM` signature(x = "ANY", model = "PiPeriodicArModel"): ...
Class PiPeriodicMaModel

Description

Class PiPeriodicMaModel.

Objects from the Class

Objects can be created by calls of the form new("PiPeriodicMaModel", ...).

Slots

\texttt{piorder}: Object of class "numeric" ~~
\texttt{picoef}: Object of class "matrix" ~~
\texttt{pcmodel}: Object of class "PeriodicArmaModel" ~~

Extends


Methods

No methods defined with class "PiPeriodicMaModel" in the signature.

\texttt{pwn_McLeodLjungBox_test}

\texttt{McLeod-Ljung-Box test for periodic white noise}

Description

Compute the McLeod-Ljung-Box test statistic for examining the null hypothesis of periodic white noise.

Usage

\texttt{pwn_McLeodLjungBox_test(acf, nepoch, use = 1:maxlag,}
\quad \texttt{maxlag = ncol(as.matrix(acf)) - 1,}
\quad \texttt{period = nrow(as.matrix(acf)), fitdf = numeric(period))}
Arguments

acf the sample periodic autocorrelation function of the time series.
nepoch number of cycles used in computing the acf.
use number of lags to use, may be a vector.
maxlag maximal lag.
period number of seasons in a cycle.
fitdf degrees of freedom corrections for the number of estimated parameters, see Details.

Details

The McLeod-Ljung-Box test can be used to test the null hypothesis of periodic white noise.
If acf contains sample autocorrelations of residuals from a fitted model, a correction of the degrees of freedom is strongly recommended.
Argument fitdf is a vector specifying how may degrees of freedom to subtract for each season. In the case of PAR models fitdf can be set to the PAR orders.
The value of the statistic is set to NA where the correction for degrees of freedom results in negative numbers.

Value

A list containing the following components:

- statistic the value of the test statistic for each lag specified by use.
- df the corresponding degrees of freedom

Note

TODO: Consolidate this and similar tests!

Author(s)

Georgi N. Boshnakov

References


See Also

*Box.test* for the non-periodic case
Class SamplePeriodicAutocorrelations

Description
Class SamplePeriodicAutocorrelations.

Objects from the Class
Objects can be created by calls of the form new("SamplePeriodicAutocorrelations",...,data).

Slots
modelCycle: Object of class "BasicCycle" ~~
data: Object of class "Lagged" ~~
n: Object of class "numeric" ~~
varnames: Object of class "character" ~~
objectname: Object of class "character" ~~

Extends

Methods
No methods defined with class "SamplePeriodicAutocorrelations" in the signature.

Class SamplePeriodicAutocovariances

Description
Class SamplePeriodicAutocovariances.

Objects from the Class
Objects can be created by calls of the form new("SamplePeriodicAutocovariances",...,data).
Slots

  modelCycle: Object of class "BasicCycle" ~~
  data: Object of class "Lagged" ~~
  n: Object of class "numeric" ~~
  varnames: Object of class "character" ~~
  objectname: Object of class "character" ~~

Extends


Methods

  autocorrelations signature(x = "SamplePeriodicAutocovariances", maxlag = "ANY", lag_0 = "missing"): ...

Methods

signature(x = "BasicCycle")
signature(x = "Cyclic")
signature(x = "VirtualPeriodicModel")

See Also

  allSeasons for related functions and examples
Description

Methods for \texttt{sigmaSq} in package \texttt{pcts}.

Methods

\begin{verbatim}
signature(object = "PeriodicIntegratedArmaSpec")
signature(object = "PeriodicInterceptSpec")
\end{verbatim}

SimpleCycle-class

Class \texttt{SimpleCycle}

Description

Class \texttt{SimpleCycle}.

Objects from the Class

Objects can be created by calls of the form \texttt{new("SimpleCycle", nseasons, seasons, first)}. In addition to number of seasons, class \texttt{"SimpleCycle"} holds also seasons' names and the index of the season to be treated as the first in a cycle.

Slots

\begin{verbatim}
seasons: Object of class "character", the names of the seasons.
nseasons: Object of class "integer", number of seasons.
cycle: Object of class "character" ~~
season: Object of class "character" ~~
abbreviated: Object of class "character" ~~
\end{verbatim}

Extends

Class \texttt{"BareCycle"}, directly. Class \texttt{"BasicCycle"}, directly.

Methods

No methods defined with class \texttt{"SimpleCycle"} in the signature.

Author(s)

Georgi N. Boshnakov
See Also

*pcCycle* for creation of cycle objects and extraction of cycle part of time series,
*BuiltinCycle-class*, *SimpleCycle-class*,
*DayWeekCycle-class*, *MonthYearCycle-class*, *OpenCloseCycle-class*, *QuarterYearCycle-class*,
*PartialCycle-class*

*BasicCycle-class* (virtual, for use in signatures)

Examples

```r
showClass("SimpleCycle")
```

---

**sim_parAcvf**  
*Create a random periodic autocovariance function*

### Description

Select randomly a periodic autoregression model and return the periodic autocovariances associated with it.

### Usage

```r
sim_parAcvf(period, order, sigma2)
```

### Arguments

- **period**: the period, a positive integer.
- **order**: the AR order, a vector of non-negative integers.
- **sigma2**: the variances of the innovations, a numeric vector of length period (todo: or one?).

### Details

Uses *sim_parCoef()* to generate a random PAR model.

### Value

An object of class "matrix". In addition, the specification of the model is in attribute "model" which is a list with the following components:

- **ar**: a matrix, the coefficients of the PAR model,
- **sigma2**: numeric, the innovation variances,
- **order**: the PAR order.

### Author(s)

Georgi N. Boshnakov
References


Examples

```r
sim_parAcvf(2, 5)
sim_parAcvf(3, 5)

res <- sim_parAcvf(2, 6)
res
slMatrix(res)[3, 4, type = "tt"]

res <- sim_parAcvf(2, 4)
attr(res, "model")
acv <- res[, ] # drop attributes
acv[2, 1 + 0]
acv[2, 1 + 1]
slMatrix(acv)[2, 0]
slMatrix(acv)[2, 1]
slMatrix(acv)[3, 4, type = "tt"]
slMatrix(acv)[1:2, 1:2, type = "tt"]
slMatrix(acv)[1:4, 1:4, type = "tt"]

## TODO: need method for autocorrelation()
## pc.acrf(acv)

## TODO: these need changing, after the change of the return values of sim_parAcvf
## pc.fcoeffs(acv, 2)
## pc.fcoeffs(acv, 3)
## pc.fcoeffs(acv, 4)
pcts:::calc_predictionCoefficients(acv, c(2, 2))
pcts:::calc_predictionCoefficients(acv, c(3, 3))
pcts:::calc_predictionCoefficients(acv, c(4, 4))
```

---

**sim_parCoef**

Generate a periodic autoregression model

Description

Generate a periodic autoregression model, possibly integrated.

Usage

```r
sim_parCoef(period, n.root, sigma2 = rep(1, period), ...)
```
Arguments

- **period**: number of seasons in a cycle.
- **n.root**: number of non-zero roots, see details.
- **sigma2**: variances of the innovations.
- **...**: additional arguments to be passed down to `sim_pcfilter`.

Details

`sim_parCoef` uses the multi-companion method to generate the model. The function is essentially a wrapper for `sim_pcfilter`.

The order of the filter is set to `n.root` for each season. Part of the spectral information may be specified with the "..." arguments, see `sim_pcfilter` and `sim_mc` for a discussion of this.

Value

A periodic autoregression model as a list with elements:

- **ar**: a matrix whose \(i\)th row contains the coefficients for the \(i\)season,
- **sigma2**: the innovation variances, a numeric vector.

Author(s)

Georgi N. Boshnakov

References


See Also

- `sim_pcfilter`

Examples

- `sim_parCoef(2, 4)`  # 2 seasons
- `sim_parCoef(2, 4, sigma2 = c(2, 4))`
- `sim_parCoef(2, 1)`
- `sim_parCoef(4, 2)`  # 4 seasons

- `sim_parCoef(period = 4, n.root = 6,`
  `eigabs = c(1, 1, 1, 0.03656887, 0.00196887),`
  `type.eigval = c("cp", "r", "r", "r", "r"),`
  `eigsign = c(pi/2, 1, -1, 1, -1))`
Simulate Periodically Correlated ARMA Series

Description

Simulate a realization of a periodically correlated arma model or a continuation of an existing series. Initial values may be given too.

Usage

\[
sim_{\text{pc}}(\text{model}, \ n = \text{NA}, \ \text{randgen} = \text{rnorm}, \ \text{seasonof1st} = 1, \ \text{nepochs} = \text{NA}, \\
\quad \text{n.start} = \text{NA}, \ x, \ \text{eps}, \ \text{nmean} = \text{NULL}, \ \text{nintercept} = \text{NULL}, \ ...)
\]

Arguments

- **model**: a list with elements `phi`, `theta`, `p`, `q`, `period`, `mean`, and `intercept`, specifying the model.
- **n**: length of the series.
- **randgen**: random number generator as required by `sim_{pwn}`.
- **seasonof1st**: season of the first value.
- **nepochs**: number of epochs; if `nepochs` is given, then `n` is computed as `nepochs * period`.
- **n.start**: burn-in number; generate `n.start + n` observations and discard the first `n.start` of them, see Details.
- **x**: initial or before values, see Details.
- **eps**: innovations, see Details.
- **nmean**: a vector of length `n` of means, see Details.
- **nintercept**: a vector of length `n` of intercepts, see Details.
- **...**: any additional arguments to be passed on to `sim_{pwn}`.

Details

Argument `x` can be used to specify two types of initialisation values - 'before' and 'init'. They are used similarly in computations but 'before' values are not included in the result, while 'init' values are (unless dropped due to `n.start`). 'Before' values provide a convenient way to simulate continuation trajectories for a time series, for example for simulation based prediction intervals.

If `x` is "numeric", it represents 'before' values. Alternatively, `x` can be a list with components "before" and "init".

Innovations are usually generated with the random number generator specified by `randgen` (with default `rnorm`) and the `...` parameters by a call to the function `sim_{pwn}`, see the documentation for `sim_{pwn}` for various ways to control the distribution of the generated sequence.

The innovations can also be generated in advance and supplied using argument `eps`. If `eps` is numeric, it is taken to represent the innovations. Alternatively, `eps` can be a list with the innovations.
in component "main". This list may also contain components "before" and/or "init" specifying 'before' or 'initial' values, with interpretation as for \( x \).

\( \text{nintercept} \) can be used to specify trend representing the effect of time and/or covariates. As for \( \text{eps} \), if it is numeric it is taken to represent the main values. It can also be a list with components \( \text{before} \), \( \text{init} \), and \( \text{main} \).

To avoid ambiguity, let's reiterate that \( \text{before} \) values are past values of the corresponding quantity (before the start of the simulated series), while \( \text{init} \) values are "initial" values. In particular, if initial values are specified for \( x \), these will form the start of the generated series (unless \( \text{n.start} \) leads to them being discarded).

If \( \text{before} \) values are specified for the series and the innovations, then they play a role analogous to that of initial values, so it does not make much sense to supply also \( \text{initial} \) values.

The function effectively does the following. \( \text{innov} \) is generated if not supplied, a vector of innovations is created \( \text{eps} <- \text{c(innovbefore,innovinit,innov)} \), a vector \( x \) is created of the same length as \( \text{eps} \), and initialised with \( \text{xbefore} \) and \( \text{xinit} \). If there are no initial or before values, these are assumed to be 0. The remaining values of \( x \) are filled using the pc-arma equations. Finally, the \( \text{xbefore} \) values are discarded as well as the first \( \text{n.start} \) values.

\( \text{n.start} \) should usually be a multiple of the period since otherwise the first observation in the returned vector will not correspond to \text{seasonof1st}.

\text{sim_pc} deals mainly with the interpretation of the parameters. The actual computations are done by \text{pc.filter}. Moreover, \text{sim_pc} does not look at the \text{model}. It knows only about \text{model$period} and uses it to compute \( n \) if \( n \) is not specified. (It probably should not care even about this.)

**Value**

numeric, the simulated time series

**To do**

option to return the innovation sequence; option to include the before values.

option to return the season of the first value in the returned series (it may be different from \text{seasonof1st} due to \( \text{n.start} \)).

**Author(s)**

Georgi N. Boshnakov

**See Also**

\text{sim_pwn, pc.filter}

**Examples**

\begin{verbatim}
ml <- rbind( c(1, 0.8, 0), c(1, 0.4972376, 0.4972376) )
testphi <- slMatrix( init = ml )

m2 <- rbind( c(1, 0, 0), c(1, 0, 0) )
testtheta <- slMatrix( init = m2 )
\end{verbatim}
## phi and theta are slMatrix here.
mo1 <- list(phi = testphi, theta = testtheta, p = 2, q = 2, period = 2)
set.seed(1234)
a1 <- sim_pc(mo1, 100)

## phi and theta are ordinary matrices here.
mo2 <- list(phi = m1[ , 2:ncol(m1)], theta = m2[ , 2:ncol(m2)], p = 2, q = 2, period = 2)
set.seed(1234)
a2 <- sim_pc(mo2, 100)
identical(a1, a2)

## Lina's PAR model
parcoef <- rbind(c(0.5, -0.06), c(0.6, -0.08),
c(0.7, -0.1), c(0.2, 0.15 ))
picoef1 <- c(0.8, 1.25, 2, 0.5)
parcoef2 <- pilar2par(picoef1, parcoef)
picoef2 <- c(4, 0.25, 5, 0.2)
coefper2I2 <- pilar2par(picoef2, parcoef2)

#### specify the model using multi-companion approach
mc2I2 <- mcompanion::mc_from_filter(coefper2I2)
co2I2 <- eigen(mc2I2)$vectors
co2I2
m2I2 <- mcompanion::sim_pcfilter(period = 4, n.root = 4,
eigabs = c(1, 0.036568887, 0.001968887),
eigsign = c(1, 1, -1),
len.block = c(2, 1, 1),
type.eigval = c("r", "r", "r"),
co = cbind(co2I2[,1], rep(NA, 4), co2I2[,3:4]))

m2I2$pcfilter
perunit2mc <- sim_pc(list(phi = m2I2$pcfilter, p = 4, q = 0, period = 4), 500)
plot(perunit2mc)
plot(perunit2mc, type = "p")

# todo: give example with sigmat^2 !!!

---

**sim_pwn**

*Simulate periodic white noise*

**Description**

Generates a sample from periodic white noise.

**Usage**

`sim_pwn(n = 100, period = NA, seasonof1st = 1, scale = NULL,
shift = NULL, f = rnorm, ...)`
Arguments

- **n**: length of the generated sample.
- **period**: number of seasons in an epoch.
- **seasonof1st**: season of the first observation in the result.
- **scale**: scale the series by this amount, a vector of length period or 1.
- **shift**: shift the series by this amount, a vector of length period or 1.
- **f**: a function or list of functions to generate random numbers.
- **...**: arguments for the random number generator(s) specified by f.

Details

First a series, say $x$, of random numbers is generated as requested by the argument $f$. Then, if $\text{shift}$ and/or $\text{scale}$ are supplied, the values are modified as follows:

$$y_t = \text{shift}_k + \text{scale}_k x_t$$

where $k$ is the season corresponding to time $t$. The vector $y$ is returned.

If $f$ is a single a function (or name of a function), then the series is generated (effectively) by the call $f(n,...)$.

The argument $f$ may also be a list whose $k$th element is itself a list specifying the random number generator for the $k$th season. The first element being the function (such as rnorm) and the remaining elements being parameters for that function. Parameters common to all seasons may be supplied through the ...argument.

The argument **period** may be omitted. In that case it is inferred from $f$ and/or the lengths of $\text{shift}$ and $\text{scale}$. Currently there is no check for consistency here.

The arguments $\text{shift}$ and $\text{scale}$ may be used to specify simple linear transformations of the generated values, possibly different for the different seasons. Each of them should be a vector of length period or one.

$\text{seasonof1st}$ can be used to request the simulated time series to start from a season other than the first one. Note that whatever the value of $\text{seasonof1st}$, the first elements of $\text{scale}$, $\text{shift}$ and $f$ (if a list) are taken to refer to season one.

Value

A vector of length $n$ representing a realization of a periodic white noise series. The season of the first observation is $\text{seasonof1st}$.

Level

0 (base)

Author(s)

Georgi N. Boshnakov
Examples

```r
## three equivalent ways to specify periodic white noise with
## normal innovations, 2 seasons, s.d. = 0.5 for season 1, and 2 for season 2
sim_pwn(100, f = rnorm, scale = c(0.5, 2))
sim_pwn(n = 100, scale = c(0.5, 2)) # rnorm is the default generator
sim_pwn(100, f = list(c(rnorm, 0, 0.5), c(rnorm, 0, 2)))
```

Description

Class SiPeriodicArmaModel.

Objects from the Class

Objects can be created by calls of the form `new("SiPeriodicArmaModel",...)`.

Slots

- `iorder`: Object of class "numeric"
- `siorder`: Object of class "numeric"
- `pcmodel`: Object of class "PeriodicArmaModel"

Extends

Class "VirtualPeriodicFilterModel", directly. Class "PeriodicIntegratedArmaSpec", directly.

Methods

No methods defined with class "SiPeriodicArmaModel" in the signature.

Description

Class SiPeriodicArModel.

Objects from the Class

Objects can be created by calls of the form `new("SiPeriodicArModel",...)`. 
SiPeriodicMaModel-class

Description

Class SiPeriodicMaModel.

Objects from the Class

Objects can be created by calls of the form `new("SiPeriodicMaModel",...)`.

Slots

- iorder: Object of class "numeric"
- siorder: Object of class "numeric"
- pcmodel: Object of class "PeriodicArmaModel"

Extends


Methods

No methods defined with class "SiPeriodicMaModel" in the signature.
sl_utils  Functions for some basic operations with seasons

Description

Functions for some basic operations with seasons.

Usage

toSeason(t, period, t1 = 1, from = 1)
toSeasonPair(t, s, period, ...)
ttTosl(r, period)
ttmatToslPairs(i, j, period)

Arguments

r  covariance matrix, see ‘Details’.
t  a vector of integers, representing times.
s  a vector of integers, representing times.
period  the number of seasons.
t1  time corresponding to the first season, an integer number.
from  1 or 0, depending on whether the season numbers start from 1 or 0.
i  a vector of integers.
j  a vector of integers.
...  todo: describe!

Details

ttmatToslPairs(i, j, period) transforms time-time pairs to season-lag pairs. The time pairs are obtained by pairing each element of i with each element of j. A four column matrix is created with one row for each pair (t, s), such that t=i[m] and s=j[n] for some m and n. The row is m, n, s, l, where (s, l) is the season-lag pair corresponding to (t, s).

ttTosl(r, period) converts autocovariances given in a covariance matrix (i.e. in “tt” form) to the “sl” form. The result is a period x (maxlag+1) matrix, where maxlag is the maximal lag available in r. Entries for which no values are available are filled with NA’s. Warning is given if contradictory entries are found (i.e. if r is not from a periodically correlated process with the given period).

toSeason(t, period, t1 = 1, from = 1) returns the season corresponding to t. t1 is a time (integer) whose season is the first season, from is 1 if the numbering of seasons is 1,2,...,period, or 0 if the numbering of seasons is 0,1,...,period-1. Other values for from are not admissible (but not checked).

Note: some of the functions in this package implicitly assume that t1=1 and from=1.

toSeasonPair(t, s, period) converts the “tt” pair t, s to “sl” pair and returns the result in the form of a list with elements season and lag. Currently t and s must be scalars.
pc.omitneg helps to implement dropping of negative indices in season-lag objects. It returns its first argument, `lags`, if all of its elements are non-negative. Otherwise, all elements of `lags` must be non-positive. In this case the function creates the vector `0:maxlag` and drops the elements specified by `lags`. Note that the default indexing will not work properly since zero elements in an index are omitted (and there are such indices in season-lag objects).

**Value**

- for `ttmatToslPairs`, a matrix with four columns;
- for `ttTosl`, a matrix with period rows;
- for `toSeason(t, period, t1=1, from=1)`, a vector of integers;
- for `toSeasonPair(t, s, period)`, a list with elements `season` and `lag`;
- for `pc.omitneg`, a vector of lags (non-negative integers).

**Note**

2013-10-24 - Corrected the description of the return value of `ttmatToslPairs`. It incorrectly stated that the first two columns are "tt" pair (they are actually indices in i and j).

**Author(s)**

Georgi N. Boshnakov

**References**


**Examples**

```r
# ttmatToslPairs
ttmatToslPairs(3, 3, 4) # 1, 1, 3, 0
ttmatToslPairs(3, 2, 4) # 1, 1, 3, 1

ttmatToslPairs(1:4, 1:4, 4)

ttmatToslPairs(3:4, 3:4, 4)

# ttTosl - :todo:

toSeason(1:10, 4) # 1 2 3 4 1 2 3 4 1 2

toSeason(1:10, 4, from = 0) # 0 1 2 3 0 1 2 3 0 1

# first data is for 3rd quarter
toSeason(1:10, 4, t1 = 3) # 3 4 1 2 3 4 1 2 3 4

# toSeasonPair
toSeasonPair(3, 3, period=4) # season=3, lag = 0
```
toSeasonPair(8, 8, period=4) # season=4, lag = 0
toSeasonPair(3, 2, period=4) # season=3, lag = 1
toSeasonPair(7, 6, period=4) # same

#### # pc.omitneg
#### pc.omitneg(0:5,10) # 0:5, unchanged since all values >= 0
####
#### pc.omitneg(-(0:5),10) # 6:10, works like
#### (0:10)[-(0:5 +1)] # same
####
#### # don't mix positive and negative numbers in pc.omitneg
#### \dontrun{pc.omitneg(c(0,2,3,-4,5), 10)}

---

**SubsetPM-class**

**Class SubsetPM**

**Description**

Class "SubsetPM" - subset PAR models with trigonometric parameterisation.

**Objects from the Class**

Objects can be created by calls of the form new("SubsetPM",...) but they are typically created by model fitting functions, see the examples.

**Slots**

theTS: "ANY", the time series to which the model is fitted.
period: "integer", the period.
order: "integer", the order.
findex: "function".
harmonics: "integer", Fourier harmonics to include in the model.
call: "call", the call used to fit the model.
other: "namedList".

**Methods**

cof signature(object = "SubsetPM"): ...
fitted signature(object = "SubsetPM"): ...
residuals signature(object = "SubsetPM"): ...
show signature(object = "SubsetPM"): ...
vcov signature(object = "SubsetPM"): ...
Examples

```r
pcfr4 <- pcts(dataFranses1996)[[4]]
x4 <- as.numeric(window(pcfr4, start = availStart(pcfr4), end = availEnd(pcfr4)))

## without 'harmonics' these models are equivalent
tmpfit <- fit_trigPAR_optim(x4, 2, 4, tol = 1e-14, verbose = FALSE)
tmpfitL <- fit_trigPAR_optim(x4, 2, 4, tol = 1e-14, type = "bylag", verbose = FALSE)

## for comparison
tmpfitP <- pclsdf(x4, 4, 1:2, sintercept = FALSE)

## with intercept
tmpfitc <- fit_trigPAR_optim(x4, 2, 4, tol = 1e-14, verbose = FALSE, sintercept = TRUE)
tmpfitcn <- fit_trigPAR_optim(x4, 2, 4, tol = 1e-14, verbose = FALSE, sintercept = structure(TRUE, merge = TRUE))
tmpfitLc <- fit_trigPAR_optim(x4, 2, 4, tol = 1e-14, type = "bylag", verbose = FALSE, sintercept = TRUE)

coef(tmpfitc, matrix = TRUE)
coef(tmpfitcn, matrix = TRUE)
coef(tmpfitLc, matrix = TRUE)

coef(tmpfitc)
coef(tmpfitcn)
coef(tmpfitLc)

coef(tmpfit)
coef(tmpfitL)

predict(tmpfitc, n.ahead = 4)
predict(tmpfitcn, n.ahead = 4)

sqrt(diag((vcov(tmpfitL))))
e <- residuals(tmpfitL)
fi <- fitted(tmpfitL)
```

test_piar

Test for periodic integration

Description

Test if a time series is periodically integrated.

Usage

```r
test_piar(x, d, p, sintercept = FALSE, sslope = FALSE, homoschedastic = FALSE)
```
Arguments

- x: time series
- d: period
- p: autoregressive order, a positive integer
- sintercept: if TRUE, include seasonal intercept
- sslpe: if TRUE, include seasonal slope
- homoschedastic: if TRUE, assume the innovations variance is the same for all seasons

Details

Computes test statistics for Franses (1996) test for periodic integration of order 1. The test is based on periodic autoregression of order \( p \), where \( p \) can be any positive integer.

Value

A list with the following components:

- p: autoregressive order.
- spec: values of sintercept, sslpe, and homoschedastic, a named logical vector.
- statistics: a matrix containing the test statistics (first row) and the corresponding p-values (second row). "LR" is not normalised, so its p-value is NA.

Note

Currently only the case \( p = 1 \) is handled, for \( p > 1 \) the statistics are set to NA. \textbf{TODO: handle this.}

All statistics are computed but some p-values are not computed yet.

Author(s)

Georgi N. Boshnakov

References


See Also

pclspliar, pclsdf
Examples

ts1 <- window(dataFranses1996[, "CanadaUnemployment"],
             start = c(1960, 1), end = c(1987, 4))
test_piar(ts1, 4, 1, sintercept = TRUE)
pcTest(ts1, "piar", 4, 1, sintercept = TRUE) # same

test_piar(ts1, 4, 1, sintercept = TRUE, sslope = TRUE)
test_piar(ts1, 4, 1)
test_piar(ts1, 4, 1, homoschedastic = TRUE)

Description

Methods for unitCycle() in package pcts.

Methods

signature(x = "ANY")
signature(x = "DayWeekCycle")
signature(x = "FiveDayWeekCycle")
signature(x = "MonthYearCycle")
signature(x = "OpenCloseCycle")
signature(x = "QuarterYearCycle")
signature(x = "SimpleCycle")
signature(x = "Cyclic")
signature(x = "Every30MinutesCycle")
signature(x = "VirtualPeriodicModel")

See Also

allSeasons for related functions and examples.

Description

Methods for `unitCycle<-` in package pcts.

Methods

signature(x = "Cyclic")
signature(x = "SimpleCycle")
Methods for `unitSeason<-` in package pcts

Description

Methods for `unitSeason<-` in package pcts.

Methods

signature(x = "Cyclic")
signature(x = "SimpleCycle")

See Also

allSeasons for related functions and examples
Description

Core data of periodic time series.

Usage

Vec(x, ...)

Vec(x, ...)

tsMatrix(x, ...)  

tsVector(x, ...)

tsVec(x, ...)

pcMatrix(x, ...)

pcArray(x, ndim = 3, ...)

pctsArray(x, ndim = 3, ...)

Arguments

x  an object.

... further arguments for methods.

ndim currently not used.

Details

These functions give the core data in various common forms.

The data values can be extracted as a vector from a periodic time series object, say x, with as.vector(x) or as(x,"vector"). Similarly, as.matrix() and as(x,"matrix") extract the data as a matrix containing one column per variable. For multivariate time series the vector returned by as.vector(x) (or as(x,"vector")) is equivalent to as.vector(as.matrix(x)).

Vec() is like as.vector() but returns the result as a matrix with one column (column vector), as is usual in matrix calculus. The default does literally this:

The most common representation of data in statistics is matrix-like with one column per variable. The descriptions of algorithms for multivariate time series however usually define the vector of observations at a given time to be a column vector. In particular, implementations of the Kalman filter often require precisely this arrangement.

In that case the data matrix is the transposed of the more common one and the vectorising operation stacks the observations, not the variables.
The functions `tsMatrix()`, `tsVector()` and `tsVec()` provide the analogues of `as.vector()`, `as.matrix()` and `Vec()` for the “transposed” arrangement.

These functions may look redundant since they are simple combinations of the above and transpose operations. Having functions makes for more readable programming. They may be more efficient, as well, for example if the underlying time series class stores the data in the transposed format.

`pcMatrix()` and `pcArray()` also give the core data. Effectively, they give an additional dimension to the seasons. The season becomes the first dimension since for column oriented data the season changes fastest. `pcMatrix` is most suitable for univariate time series, `pcArray()` for multivariate. Note that `pcArray()` easily extends to multiple periodicities although currently (2019-04-19) there are no methods that exploit this.

For univariate time series, in the matrix returned by `pcMatrix()` each row represents the data for one season and each column for one cycle. For multivariate time series, the matrices for each variable are put next to each other.

`pcArray()` returns the data as an array, whose last dimension corresponds to variables. In the default case the array is 3-dimensonal with dimensions (season, year, variable).

`pctsArray()` is a variant of `pcArray()` corresponding to the arrangement of `tsMatrix()`. The ordering of the dimensions here is (variable, season, cycle).

Value

vector, matrix or array, as indicated by the name of the function and described in Details.

Author(s)

Georgi N. Boshnakov

Examples

```r
## window to make number of years different from number of months
ap <- pcts(window(AirPassengers, start = c(1956, 1)))
class( as.vector(ap) )
class( as(ap, "vector") )

dim( as.matrix(ap) )
dim( as(ap, "matrix") )

dim( tsMatrix(ap) )
class( tsVector(ap) )
dim( tsVec(ap) )

dim( pcMatrix(ap) )
dim( pcArray(ap) )
dim( pctsArray(ap) )

dfr <- pcts(dataFranses1996)
dim(dfr) # c(148, 19)
nSeasons(dfr) # 4
```
length(as.vector(dfr))

all.equal(as.vector(dfr)[1:148], as.matrix(dfr)[, 1]) # TRUE
all.equal(tsVector(dfr)[1:19], unname(as.matrix(dfr)[1, ])) # TRUE

dim( as.matrix(dfr) ) # c(148, 19)
dim( tsMatrix(dfr) ) # c(19, 148)
all.equal(tsMatrix(dfr)[, 1], as.matrix(dfr)[1, ]) # TRUE

dim( Vec(dfr) )
dim( tsVec(dfr) )
all.equal(tsVec(dfr)[1:19], unname(as.matrix(dfr)[1, ])) # TRUE

dim( pcMatrix(dfr) ) # c(4, 703), one row for each season
dim( pcArray(dfr) ) # c(4, 37, 19), note: 703 == 37×19

dim( pctsArray(dfr) ) # c(19, 4, 37), note: 703 == 37×19

---

zoo-class

Class zoo made S4

Description

Class zoo made S4

Objects from the Class

A virtual Class: No objects may be created from it.
S4 Class "zoo" is derived from its namesake in package zoo for use as a super class for periodic time series classes and in S4 method signatures.

Slots

.S3Class: Object of class "character" ~

Extends

Class "oldClass", directly.

Methods

No methods defined with class "zoo" in the signature.

See Also

PeriodicTS_zooreg, zooreg and package zoo

Examples

showClass("zoo")
Virtual S4 class zooreg

Objects from the Class

A virtual Class: No objects may be created from it.

S4 Class "zooreg" is derived from its namesake in package zoo for use as a super class for periodic time series classes and in S4 method signatures.

Slots

.S3Class: Object of class "character" ~

Extends

Class "zoo", directly. Class "oldClass", by class "zoo", distance 2.

Methods

No methods defined with class "zooreg" in the signature.

See Also

PeriodicTS_zooreg, zoo and package zoo

Examples

showClass("zooreg")

Indexing of objects from classes in package pcts

Description

Indexing of objects from classes in package pcts.
Methods

signature(x = "BasicCycle", i = "ANY", j = "missing", drop = "ANY")
signature(x = "BasicCycle", i = "missing", j = "missing", drop = "ANY")
signature(x = "PeriodicMTS", i = "ANY", j = "missing", drop = "ANY")
signature(x = "PeriodicMTS", i = "missing", j = "missing", drop = "ANY")
signature(x = "PeriodicVector", i = "ANY", j = "ANY", drop = "ANY")
signature(x = "PeriodicVector", i = "ANY", j = "missing", drop = "ANY")
signature(x = "PeriodicVector", i = "missing", j = "ANY", drop = "ANY")
signature(x = "PeriodicVector", i = "missing", j = "missing", drop = "ANY")
signature(x = "VirtualPeriodicAutocovarianceModel", i = "missing", j = "missing", drop = "ANY")
signature(x = "VirtualPeriodicAutocovarianceModel", i = "missing", j = "numeric", drop = "ANY")
signature(x = "VirtualPeriodicAutocovarianceModel", i = "numeric", j = "missing", drop = "ANY")
signature(x = "VirtualPeriodicAutocovarianceModel", i = "numeric", j = "numeric", drop = "ANY")
signature(x = "PeriodicTS", i = "missing", j = "missing", drop = "ANY")
signature(x = "PeriodicMTS", i = "ANY", j = "ANY", drop = "ANY")
signature(x = "PeriodicMTS", i = "AnyDateTime", j = "ANY", drop = "ANY")
signature(x = "PeriodicMTS", i = "AnyDateTime", j = "missing", drop = "ANY")
signature(x = "PeriodicTS", i = "AnyDateTime", j = "missing", drop = "ANY")

Author(s)

Georgi N. Boshnakov

Description

Index assignments for objects from classes in package pcts.

Methods

signature(x = "PeriodicVector", i = "ANY", j = "ANY", value = "ANY")
signature(x = "PeriodicVector", i = "missing", j = "ANY", value = "ANY")
signature(x = "BasicCycle", i = "ANY", j = "missing", value = "ANY")
signature(x = "BasicCycle", i = "missing", j = "missing", value = "ANY")
signature(x = "PeriodicAutocovarianceModel", i = "ANY", j = "ANY", value = "ANY")
Author(s)
Georgi N. Boshnakov

[[[-methods

Methods for function `[[` in package `pcts`

Description
Methods for function `[[` in package `pcts`.

Methods
signature(x = "PeriodicMTS", i = "ANY", j = "ANY")
signature(x = "VirtualPeriodicAutocovarianceModel", i = "numeric", j = "ANY")

$-methods

Methods for function `$` in package `pcts`

Description
Methods for function `$` in package `pcts`.

Methods
signature(x = "PeriodicMTS")
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