Package 'EpiSignalDetection'

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Type Package

Title Signal Detection Analysis

Version 0.1.2

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Description Exploring time series for signal detection. It is specifically designed
to detect possible outbreaks using infectious disease surveillance data
at the European Union / European Economic Area or country level.
Automatic detection tools used are presented in the paper
``Monitoring count time series in R: aberration detection in public health surveillance",
by Salmon (2016) <doi:10.18637/jss.v070.i10>.
The package includes:
- Signal Detection tool, an interactive 'shiny' application
in which the user can import external data and perform basic signal detection analyses;
- An automated report in HTML format, presenting the results of the time series analysis in tables and graphs.
This report can also be stratified by population characteristics (see 'Population' variable).
This project was funded by the European Centre for Disease Prevention and Control.

Depends R (>= 3.4.0)

License EUPL

Encoding UTF-8

LazyData true

RoxygenNote 7.1.2

Imports dplyr, graphics, ISOweek, rmarkdown, shiny, surveillance,
utils

Suggests DT, ggplot2, knitr (>= 1.20), pander

VignetteBuilder knitr

SystemRequirements pandoc (>= 1.12.3)

URL https://github.com/EU-ECDC/EpiSignalDetection

NeedsCompilation no

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R topics documented:

`aggAtlasExport` *Aggregate filtered final Atlas export*

Description

Aggregate filtered final Atlas export

Usage

```
aggAtlasExport(x, input)
```

Arguments

`x`	dataframe
`input`	list of parameters as defined in the Signal Detection Application (see `runEpiSDApp`) (i.e. `list(disease,country,indicator,stratification,unit,daterange,algo,testingperiod)`

Value

dataframe aggregated by geographical level and time unit

See Also

filterAtlasExport SignalData stsSD

Examples

```
#-- Setting the parameters to run the report for
input <- list(
disease = "Salmonellosis",
country = "EU-EEA - complete series",
indicator = "Reported cases",
stratification = "Confirmed cases",
unit = "Month",
daterange = c("2010-01-01", "2016-12-31"),
algo = "FarringtonFlexible",
testingperiod = 5
)

#-- Example dataset
dataset <- EpiSignalDetection::SignalData

#-- Filtering on declared input parameters
dataset <- filterAtlasExport(dataset, input)

#-- Aggregating the data by geographical level and time point
dataset <- aggAtlasExport(dataset, input)
```

AlgoParam *List of datasets containing the Farrington Flexible and GLRNB default parameters by time unit*

Description

A list including two datasets containing the parameters used for Farrington Flexible and for GLRNB for each time unit available in the Signal Detection tool

Usage

```
AlgoParam
```

Format

A list of 2 dataframes: one with 2 rows and 9 variables and GRLNB with 2 rows and 8 variables

1. **Default parameters for FarringtonFlexible algorithm**

   timeunit Time units available in the signal detection tool i.e. week, month

   w Window's half-size, i.e. number of weeks to include before and after the current week in each year (w=2 for weeks, w=1 for months)

reweight Logical specifying whether to reweight past outbreaks or not (TRUE for both weeks and months, past outbreaks are always reweighted)

trend Logical specifying whether a trend should be included and kept in case the conditions in the Farrington et. al. paper are met. (TRUE for both weeks and months, a trend is always fit)

weightsThreshold Numeric defining the threshold for reweighting past outbreaks using the Anscombe residuals (2.85 for both weeks and months, as advised in the improved method)

glmWarnings Logical specifying whether to print warnings from the call to glm (TRUE for both weeks and months)

pThresholdTrend Numeric defining the threshold for deciding whether to keep trend in the model (0.05 for both weeks and months)

limit54_1 Integer, the number of cases defining a threshold for minimum alarm, no alarm is sounded if fewer than 'limit54_1' cases were reported in the past 'limit54_2' weeks/months

limit54_2 Integer, the number of periods defining a threshold for minimum alarm, no alarm is sounded if fewer than 'limit54_1' cases were reported in the past 'limit54_2' weeks/months

2. **Default parameters for GLRNB algorithm**

timeunit Time units available in the signal detection tool i.e. week, month

mu0 A vector of in-control values of the mean of the Poisson / negative binomial distribution with the same length as range - NULL for both weeks and months

theta Numeric, the pre-specified value for k or lambda is used in a recursive LR scheme - log(1.2) for both weeks and months corresponding to a 20 percent increase in the mean

alpha Numeric, the dispersion parameter of the negative binomial distribution. If alpha=NULL the parameter is calculated as part of the in-control estimation - alpha=NULL for both weeks and months

cARL Numeric, the threshold in the GLR test, i.e. c_gamma - cARL=0.25 for both weeks and months

Mtilde Integer, the number of observations needed before we have a full rank - Mtilde=1 for both weeks and months

M Integer defining the number of time instances back in time in the window-limited approach. To always look back until the first observation use M=-1. M=1 for both weeks and months

Change Character string specifying the type of the alternative. Currently the two choices are intercept and epi - Change=intercept for both weeks and months

See Also

`surveillance::farringtonFlexible` `surveillance::glrnb`

`algoSD` *Build algo object*

Description

Build algo object from an sts object class using either FarringtonFlexible or GLRNB surveillance algorithm

Usage

```
algoSD(x.sts, algo = "FarringtonFlexible", timeUnit = "Month", testingPeriod = 5)
```

Arguments

x.sts	sts class object (see stsSD output)
algo	character string containing the name of the algorithm to use. Options are "FarringtonFlexible" (default) or "GLRNB".
timeUnit	character string for the time unit of the time series. Options are "Week" or "Month".
testingPeriod	numeric: number of time units (months, weeks) back in time to test the algorithm on (to detect outbreaks in)

Value

sts

See Also

stsSD plotSD

Examples

```
#-- Setting the parameters to run the report for
input <- list(
disease = "Salmonellosis",
country = "EU-EEA - complete series",
indicator = "Reported cases",
stratification = "Confirmed cases",
unit = "Month",
daterange = c("2010-01-01", "2016-12-31"),
algo = "FarringtonFlexible",
testingperiod = 5
)

#-- Example dataset
dataset <- EpiSignalDetection::SignalData

#-- Filtering on declared input parameters
dataset <- filterAtlasExport(dataset, input)

#-- Aggregating the data by geographical level and time point
dataset <- aggAtlasExport(dataset, input)

#-- Bulding the corresponding sts object
dataset.sts <- stsSD(observedCases = dataset$NumValue,
                     studyPeriod = dataset$StudyPeriod,
                     timeUnit = input$unit,
              startYM = c(as.numeric(format(as.Date(input$daterange[1], "%Y-%m-%d"), "%Y")),
                      as.numeric(format(as.Date(input$daterange[1], "%Y-%m-%d"), "%m"))))
```

```
#-- Building the corresponding algo object
dataset.algo <- algoSD(dataset.sts,
                       algo = input$algo,
                       timeUnit = input$unit,
                       testingPeriod =
                       input$testingperiod)
```

`cleanAtlasExport` *Clean the Atlas export dataframe*

Description

Clean the Atlas data export dataframe before signal detection analysis
(see `importAtlasExport` and online ECDC Atlas: http://atlas.ecdc.europa.eu/public/index.aspx)

Usage

```
cleanAtlasExport(x)
```

Arguments

`x`	dataframe, usually the ouput of the import function `importAtlasExport(x)`

Details

The function will:

- Filter only on case based indicators i.e. 'Reported Cases"
- Create four additional time variables to ease the analysis:
  TimeUnit ('Year', 'Month', 'Week'),
  TimeYear (xxxx),
  TimeMonth (xx)
  TimeWeek(xx)
- Keep only variables of interest i.e. "HealthTopic", "Population", "Time", "RegionName", "NumValue"

Value

dataframe

See Also

`importAtlasExport` `filterAtlasExport`

Examples

```
## Not run:
dataset <- cleanAtlasExport( importAtlasExport(x = 'ECDC_surveillance_data_Anthrax.csv') )

## End(Not run)
```

`filterAtlasExport` *Filter clean Atlas export*

Description

Filter clean Atlas export according to input parameters

Usage

```
filterAtlasExport(x, input, stratified)
```

Arguments

`x`	dataframe, clean Atlas export (see `cleanAtlasExport`)
`input`	list of parameters as defined in the Signal Detection Application (see `runEpiSDApp`) (i.e. `list(disease,country,indicator,stratification,unit,daterange,algo,testingperiod)`
`stratified`	a logical value indicating whether the report should be stratified by `Population` variable or not (default `FALSE`)

Value

dataframe filtered on the selected parameters (input list)

See Also

`cleanAtlasExport` `aggAtlasExport`

Examples

```
#-- Setting the parameters to run the report for
input <- list(
disease = "Salmonellosis",
country = "EU-EEA - complete series",
indicator = "Reported cases",
stratification = "Confirmed cases",
unit = "Month",
daterange = c("2010-01-01", "2016-12-31"),
algo = "FarringtonFlexible",
testingperiod = 5
)
```

```
#-- Example dataset
dataset <- EpiSignalDetection::SignalData

#-- Filtering on declared input parameters
dataset <- filterAtlasExport(dataset, input, stratified = FALSE)
```

`importAtlasExport` *Import ECDC Atlas export file (csv)*

Description

Import ECDC Atlas csv export file
(exported from the online ECDC Atlas: http://atlas.ecdc.europa.eu/public/index.aspx)
e.g. "ECDC_surveillance_data_Anthrax.csv"

Usage

```
importAtlasExport(x)
```

Arguments

x	file name of a csv file, export from the ECDC Atlas (e.g. `x = 'ECDC_surveillance_data_Anthrax.csv'`)

Details

The function will interpret missing reports '-' as NA values

Value

dataframe

See Also

`cleanAtlasExport`

Examples

```
## Not run:
dataset <- importAtlasExport(x = 'ECDC_surveillance_data_Anthrax.csv')

## End(Not run)
```

plotSD *Plot the Signal Detection time series*

Description

Plot the Signal Detection time series including historical data, alarm detection period and alarms

Usage

```
plotSD(x, input, subRegionName, x.sts, x.algo)
```

Arguments

x	dataframe (default SignalData)
input	list of parameters as defined in the Signal Detection Application (see runEpiSDApp) (i.e. list(disease,country,indicator,stratification,unit,daterange,algo,testingperiod)
subRegionName	character string, region label to use in the plot, if different than input$RegionName (optional)
x.sts	sts object (optional), see stsSD)
x.algo	algo object (optional), see algoSD)

Value

plot

See Also

SignalData runEpiSDApp

Examples

```
#-- Setting the parameters to run the report for
input <- list(
disease = "Salmonellosis",
country = "EU-EEA - complete series",
indicator = "Reported cases",
stratification = "Confirmed cases",
unit = "Month",
daterange = c("2010-01-01", "2016-12-31"),
algo = "FarringtonFlexible",
testingperiod = 5
)

#-- Plotting the signal detection output
plotSD(input = input)
```

`runEpiSDApp` *Run the EpiSignalDectection 'shiny' application*

Description

Run the 'shiny' interactive application for signal detection analysis using ECDC Atlas export data.

Usage

```
runEpiSDApp()
```

Details

Datasets to use in the tool:

- Default dataset included in the application (Salmonellosis 2007-2016 or Measles 1999-2018 data);
- External dataset using the "Browse" button in the application:
  - –> An export (csv format) from the ECDC Surveillance Atlas of Infectious Diseases: http://atlas.ecdc.europa.eu/public/index.aspx.
    On the ECDC "Surveillance Atlas of Infectious Diseases" web site:
    - 1- Choose the disease/health topic to analyse
    - 2- Export the data (csv) using the default settings
    - 3- Import the csv in the application
    - 4- You can now explore the disease time series for signal detection...
  - –> Any dataset specified as described in the package vignette.

Examples

```
## Not run:
# --- Run the 'shiny' app
# --- (NB: please open the app in an external browser
# --- in order to facilitate its use)
runEpiSDApp()

## End(Not run)
```

runEpiSDReport *Run the EpiSignalDetection report (HTML markdown)*

Description

Function to render the markdown report of alarms in HTML format for ECDC Signal Detection Report

Usage

```
runEpiSDReport(input, stratified, outputfile, run_pandoc = TRUE)
```

Arguments

input	list of parameters as defined in the Signal Detection Application (see runEpiSDApp) (i.e. list(disease,country,indicator,stratification,unit,daterange,algo,testingperiod) (see also default parameters in system.file("SignalDetectionReport_HTML","SignalDetectionRep = "EpiSignalDetection"))
stratified	a logical value indicating whether the report should be stratified by Population variable or not (default FALSE)
outputfile	output file name (e.g. 'C:/R/report.html') (default value is a temporary folder - file.path(tempdir(),"SignalDectectionReport.html"))
run_pandoc	An option for whether to run pandoc to convert Markdown output.

Details

Datasets to use in the report:

- Default dataset included in the package (Salmonellosis 2007-2016 or Measles 1999-2018 data) (i.e. input$file = NULL);
- External dataset:
  - –> An export (csv format) from the ECDC Surveillance Atlas of Infectious Diseases: http://atlas.ecdc.europa.eu/public/index.aspx.
    On the ECDC "Surveillance Atlas of Infectious Diseases" web site:
    * 1- Choose the disease/health topic to analyse
    * 2- Export the data (csv) using the default settings
    * 3- Specify the location of this external dataset in the input argument of the runEpiSDReport() function (e.g. input <-list(file = list(datapath = "C:/Users/Downloads/ECDC_surveillan = "Pertussis",country = "Greece",indicator = "Reported cases",stratification = "All cases",unit = "Month",daterange = c("2011-12-01","2016-12-01"),algo = "FarringtonFlexible",testingperiod = 3))
    * 4- You can now render the re markdown report... (e.g. runEpiSDReport(input = input))
  - –> Any dataset specified as described in the package vignette.

Value

An HTML report. When run_pandoc = TRUE, the compiled document is written into the output file, and the path of the output file is returned. When run_pandoc = FALSE, the path of the Markdown output file, with attributes knit_meta (the **knitr** meta data collected from code chunks) and intermediates (the intermediate files/directories generated by render())

See Also

Default dataset used in the report SignalData

Signal Detection Application runEpiSDApp

Examples

```
## Not run:
#-- Running the report as a standalone function
runEpiSDReport()    #Definition of each input parameter
                     #is done one by one through the R console

#---> OR

#-- First setting the parameters to run the report for
input <- list(
disease = "Salmonellosis",
country = "Portugal",
indicator = "Reported cases",
stratification = "Confirmed cases",
unit = "Month",
daterange = c("2011-01-01", "2016-12-31"),
algo = "FarringtonFlexible",
testingperiod = 6
)

#-- Second running the report based on the EpiSignalDetection::SignalData dataset
#-- and store it in a temporary folder
runEpiSDReport(input = input)

#-- Running the report based on the EpiSignalDetection::SignalData dataset
#-- and store the HTML output 'test.html' in the folder 'C:/R/'
runEpiSDReport(input = input, outputfile = "C:/R/test.html")

#-- Running the report based on external data
input <- list(
file = list(datapath = "C:/Users/Downloads/ECDC_surveillance_data_Pertussis.csv"),
disease = "Pertussis",
country = "Greece",
indicator = "Reported cases",
stratification = "All cases",
unit = "Month",
daterange = c("2011-12-01", "2016-12-01"),
algo = "FarringtonFlexible",
testingperiod = 3
```

```
)

runEpiSDReport(input = input, stratified = TRUE)

## End(Not run)
```

`SignalData` *Dataset for Signal Detection Analysis, reported cases, 1999-2018 (ECDC Atlas export)*

Description

A dataset containing an export from the ECDC Atlas for salmonellosis and measles data. This export is cleaned and ready for Signal Detection Analysis (see. cleanAtlasExport())

Usage

```
SignalData
```

Format

A data frame with 80,834 rows and 11 variables:

HealthTopic Disease name e.g. Salmonellosis or Measles

Population Population characteristics e.g. All cases, Confirmed cases, Serotype AGONA, Serotype BAREILLY etc.

Indicator Indicator e.g. Hospitalised cases, Reported cases, Number of deaths, etc.

Time Time variable including both yearly data from 1999 to 2017, and monthly data from 1999-01 to 2018-02

RegionName Geographical level including country names e.g. Austria, Belgium, Bulgaria, etc.

NumValue Number of cases

TimeUnit Time unit corresponding to the format of the date in the 'Time' variable e.g. Year or Month

TimeYear Year of the date available in the 'Time' variable, regardless of the date format i.e. 1999 to 2018

TimeMonth Month of the date available in the 'Time' variable, regardless of the date format i.e. 1 to 12

TimeWeek Week of the date available in the 'Time' variable, regardless of the date format i.e. NA since this dataset does not include any weekly data

TimeDate Approximated date corresponding to the date available in the 'Time' variable (daily format)

Source

http://atlas.ecdc.europa.eu/public/index.aspx

stsSD *Build sts object*

Description

Build sts surveillance object

Usage

```
stsSD(observedCases, studyPeriod, timeUnit = "Month", startYM = c(2000, 1) )
```

Arguments

observedCases	numeric vector of the number of cases by time unit (y axis of the time series)
studyPeriod	vector of dates of length(obeservedCases) (x axis of the time series)
timeUnit	character string for the time unit of the time series. Options are Week or Month.
startYM	numeric vector including Year and Month of start of the historical data

Value

sts

See Also

aggAtlasExport algoSD

Examples

```
#-- Setting the parameters to run the report for
input <- list(
disease = "Salmonellosis",
country = "EU-EEA - complete series",
indicator = "Reported cases",
stratification = "Confirmed cases",
unit = "Month",
daterange = c("2010-01-01", "2016-12-31"),
algo = "FarringtonFlexible",
testingperiod = 5
)

#-- Example dataset
dataset <- EpiSignalDetection::SignalData

#-- Filtering on declared input parameters
dataset <- filterAtlasExport(dataset, input)

#-- Aggregating the data by geographical level and time point
dataset <- aggAtlasExport(dataset, input)
```

```
#-- Bulding the corresponding sts object
dataset.sts <- stsSD(observedCases = dataset$NumValue,
                     studyPeriod = dataset$StudyPeriod,
                     timeUnit = input$unit,
                startYM = c(as.numeric(format(as.Date(input$daterange[1], "%Y-%m-%d"), "%Y")),
                        as.numeric(format(as.Date(input$daterange[1], "%Y-%m-%d"), "%m"))))
```

`studyPeriod` *Compute the study period*

Description

Compute a dataframe including two types of dates corresponding to the study period defined in the list of parameters `input`
(i.e. `StudyPeriod` = approximated daily date; `Time` = exact date in the format according to the time unit parameter)

Usage

```
studyPeriod(input)
```

Arguments

`input`	list of parameters as defined in the Signal Detection Application (see `runEpiSDApp`) (i.e. `list(disease,country,indicator,stratification,unit,daterange,algo,testingperiod)`

Value

Dataframe including the complete time series with no gaps:

`StudyPeriod`	approximated daily date e.g. `2010-01-01`
`Time`	exact date in the format according to the time unit parameter e.g. `2010-01`

Examples

```
#-- Setting the parameters to run the report for
input <- list(
disease = "Salmonellosis",
country = "EU-EEA - complete series",
indicator = "Reported cases",
stratification = "Confirmed cases",
unit = "Month",
daterange = c("2010-01-01", "2016-12-31"),
algo = "FarringtonFlexible",
testingperiod = 5
)
```

```
StudyPeriod <- studyPeriod(input)
head(StudyPeriod)
```

Index