Package ‘mem’

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Description

This package creates the model described in the *Moving Epidemics Method* (MEM), used to monitor influenza activity during the seasonal surveillance.

Details

- **Package:** mem
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- **Title:** Moving Epidemics Method R Package.
- **Version:** 1.4
- **Date:** 2014-07-10
- **Author:** Jose E. Lozano Alonso <lozalojo@jcyl.es>
- **Maintainer:** Jose E. Lozano Alonso <lozalojo@jcyl.es>
- **Depends:** R (>= 3.1.0)
- **Description:** Modelization of influenza epidemics in order to monitor future activity.
- **License:** GPL (>= 2)

Functions to calculate the optimal timing of the epidemic and a threshold to give an early alert of the upcoming epidemic.

Author(s)

Jose E. Lozano Alonso <lozalojo@jcyl.es>.

References


Examples

```r
## Castilla y Leon Influenza Rates data
data(flucyl)
## Optimal timing of an epidemic
tim<-epitiming(flucyl[1])
print(tim)
summary(tim)
plot(tim)
## Threshold calculation
```
epimem

Function epimem is used to calculate the threshold for influenza epidemic using historical records (surveillance rates).
The method to calculate the threshold is described in the Moving Epidemics Method (MEM) used to monitor influenza activity in a weekly surveillance system.

Usage

epimem(i.data, i.type = 2, i.level = 0.95, i.type.curve = 2, i.level.curve = 0.95, i.type.threshold = 5, i.level.threshold = 0.95, i.n.max = -1, i.tails = 1, i.type.boot = "norm", i.iter.boot = 10000, i.method = 2, i.param = 2.8, i.levels = c(0.40, 0.90, 0.975), i.seasons = 10)

Arguments

i.data Data frame of input data.
i.type Type of confidence interval (general).
i.level Level of confidence interval (general).
i.type.curve Type of confidence interval (to calculate the modelled curve).
i.level.curve Level of confidence interval (to calculate the modelled curve).
i.type.threshold Type of confidence interval (to calculate the threshold).
i.level.threshold Level of confidence interval (to calculate the threshold).
i.n.max Number of pre-epidemic values used to calculate the threshold.
i.tails Tails for the confidence interval to calculate the threshold.
i.type.boot Type of bootstrap technique.
i.iter.boot Number of bootstrap iterations.
i.method Method to calculate the optimal timing of the epidemic.
i.param Parameter to calculate the optimal timing of the epidemic.
i.levels Levels of the intensity thresholds.
i.seasons Maximum number of seasons to use.
x An flu class item.
object An flu class item.
...
Not used.

Details

Input data is a data frame containing rates that represent historical influenza surveillance data. It can start and end at any given week (typically at week 40th), and rates can be expressed as per 100,000 inhabitants (or per consultations, if population is not available) or any other scale. Parameters i.type, i.type.threshold and i.type.curve defines how to calculate confidence intervals along the process. i.type.curve is used for calculating the typical influenza curve, i.type.threshold is used to calculate the pre and post epidemic threshold and i.type is used for any other confidence interval used in the method. All three parameters must be a number between 1 and 6:

1 Arithmetic mean and mean confidence interval.
2 Geometric mean and mean confidence interval.
3 Median and the KC Method to calculate its confidence interval.
4 Median and bootstrap confidence interval.
5 Arithmetic mean and point confidence interval (standard deviations).
6 Geometric mean and point confidence interval (standard deviations).

Option 4 uses two more parameters: i.type.boot indicates which bootstrap method to use. The values are the same of those of the boot.ci function. Parameter i.iter.boot indicates the number of bootstrap samples to use. See boot for more information about this topic. Parameters i.level, i.level.threshold and i.level.curve indicates, respectively, the level of the confidence intervals described above. The i.n.max parameter indicates how many pre epidemic values to use to calculate the threshold. A value of -1 indicates the program to use an appropriate number of points depending on the number of seasons provided as input. i.tails tells the program to use 1 or 2 tailed confidence intervals when calculating the threshold (1 is recommended). Parameters i.method and i.param indicates how to find the optimal timing of the epidemics. See epitiming for details on the values this parameters can have.
epimem

Value

epimem returns an object of class flu. An object of class flu is a list containing at least the following components:

- `i.data` input data
- `pre.post.intervals` Pre/post confidence intervals (Threhold is the upper limit of the confidence interval).
- `ci.length` Mean epidemic length confidence interval.
- `ci.percent` Mean covered percentage confidence interval.
- `mean.length` Mean length.
- `moving.epidemics` Moving epidemic rates.
- `mean.start` Mean epidemic start.
- `epi.intervals` Epidemic levels of intensity.
- `typ.curve` Typical epidemic curve.
- `n.max` Effective number of pre epidemic values.

Author(s)

Jose E. Lozano Alonso <lozalojo@jcyl.es>.

References


Examples

```r
## Castilla y Leon Influenza Rates data
data(flucyl)
## Finds the timing of the first season: 2001/2002
epi<-epimem(flucyl)
print(epi)
summary(epi)
plot(epi)
```
Influenza Epidemic Timing

Description

Function epitiming is used to find the optimal timing of an influenza epidemic in a set of weekly influenza surveillance rates. It provides the start and the end of the epidemic, also it returns a list of pre-epidemic and post-epidemic rates that can be used to calculate influenza baselines and thresholds.

The method to calculate the optimal timing of an epidemic is described as part of the Moving Epidemics Method (MEM), used to monitor influenza activity in a weekly surveillance system.

Usage

epitiming(i.data, i.n.values = 5, i.method = 2, i.param = 2.8)
## S3 method for class 'epidemic'
print(x, ...)
## S3 method for class 'epidemic'
summary(object, ...)
## S3 method for class 'epidemic'
plot(x, ...)

Arguments

- i.data: a numeric object (or one that can be coerced to that class).
- i.n.values: a number, which indicates how many pre-epidemic values are taken from the pre-epidemic period.
- i.method: a number from 1 to 4, to select which optimization method to use.
- i.param: an optional parameter used by the method.
- x: An epidemic class item.
- object: An epidemic class item.
- ...: Not used.

Details

Input data is a vector of rates that represent a full influenza surveillance season. It can start and end at any week (typically at week 40th), and rates can be expressed as per 100,000 inhabitants (or per consultations, if population is not available) or any other scale.

The i.n.values parameter is used to get information from the pre-epidemic and post-epidemic period. The function will extract the highest pre/post values in order to use it later to calculate other influenza indicators, such as baseline activity or threshold for influenza epidemic. Depending on the value i.method, the function will use a different method to calculate the optimum epidemic timing.

[1] original method
[2] fixed criterium method
All methods are based upon the MAP curve, as described in the MEM Method. The original method uses the process shown in the original paper, which describes the MEM as it was created. The fixed criterium method is an update of the MEM that uses the slope of the MAP curve to find the optimum, which is the point where the slope is lower than a predefined value. The slope method also calculates the slope of the MAP curve, but the optimum is the one that matches the global/mean slope. The second derivative method calculates the second derivative and equals to zero to search an inflexion point in the original curve.

Two of the four methods require an additional parameter \texttt{i.param}: for the fixed criterium method is the predefined value to find the optimum, which typically is 2.5-3.0\%, and for the original method it is needed the window parameter to smooth the map curve. A value of \texttt{-1} indicates it should use \texttt{h.select} to select the window parameter. See \texttt{sm} for more information about this topic.

Value

\texttt{epitiming} returns an object of class \texttt{epidemic}. An object of class \texttt{epidemic} is a list containing at least the following components:

\begin{verbatim}
  i.data     input data
  map.curve  MAP curve
  optimum.map optimum
  pre.epi    pre-epidemic highest rates
  post.epi   post-epidemic highest rates
\end{verbatim}

\textbf{Author(s)}

Jose E. Lozano Alonso <lozalojo@jcyl.es>.

\textbf{References}


\textbf{Examples}

\begin{verbatim}
## Castilla y Leon Influenza Rates data
data(flucyl)
## Finds the timing of the first season: 2001/2002
tim<-epitiming(flucyl[1])
print(tim)
summary(tim)
plot(tim)
\end{verbatim}
Castilla y Leon Influenza Rates

Description

This data set contains Influenza Like Illness (ILI) rates, in cases per 100,000 inhabitants collected by the Influenza Surveillance Programme of the Castilla y Leon Health Sentinel Network (CyLHSN) from 2001 to 2008.

Usage

data(flucyl)

Format

A data frame with 33 observations on 8 variables. Each observation is one surveillance week, and each variable is an influenza season.

- `R001OR00R` a numeric vector - 2001/2002 rates per 100,000 inhabitants.
- `R002OR00R` a numeric vector - 2002/2003 rates per 100,000 inhabitants.
- `R003OR00R` a numeric vector - 2003/2004 rates per 100,000 inhabitants.
- `R004OR00R` a numeric vector - 2004/2005 rates per 100,000 inhabitants.
- `R005OR00R` a numeric vector - 2005/2006 rates per 100,000 inhabitants.
- `R006OR00R` a numeric vector - 2006/2007 rates per 100,000 inhabitants.
- `R007OR00R` a numeric vector - 2007/2008 rates per 100,000 inhabitants.
- `R008OR00R` a numeric vector - 2008/2009 rates per 100,000 inhabitants.

Details

The Castilla y Leon Health Sentinel Network is a Spanish regional influenza surveillance system based upon volunteer health professionals. The Influenza Surveillance Programme consists on a random sample of general practitioners (covering 30,000 population) which collect ILI cases weekly from 40th week (October) to 20th week (May) of the following year to provide estimations of the ILI weekly rate for the entire region.


Source


References

Castilla y Leon Health Sentinel Network Reports (Informes de la Red Centinela Sanitaria de Castilla y Leon: [http://www.salud.jcyl.es/centinelas](http://www.salud.jcyl.es/centinelas)).

Influenza Surveillance Programme (Programa de vigilancia de la gripe: [http://www.salud.jcyl.es/centinelas](http://www.salud.jcyl.es/centinelas)).
Examples

data(flucl)
plot(flucl[,1],type="l")

Description

These are internal functions used by the mem package and for use of the program, it can't be used by the user since they have not been designed for general use.

memintensity

Thresholds for influenza intensity

Description

Function memintensity is used to calculate the thresholds for influenza activity using historical records (surveillance rates). This method is based on the Moving Epidemics Method (MEM) used to monitor influenza activity in a weekly surveillance system.

Usage

memintensity(i.data, i.levels = c(0.40, 0.90, 0.975), i.n.max = -1, i.seasons = 10)

Arguments

i.data Data frame of input data.
i.levels Levels of the intensity thresholds.
i.n.max Number of epidemic values used to calculate the intensity thresholds.
i.seasons Maximum number of seasons to use.

Details

Input data is a data frame containing rates that represent historical influenza surveillance data. It can start and end at any given week (typically at week 40th), and rates can be expressed as per 100,000 inhabitants (or per consultations, if population is not available) or any other scale.
MEM is used to locate the epidemic for each season. Then confidence intervals are calculated at different levels.
The parameter i.levels, define the three levels of the confidence intervals used to calculate thresholds.
The i.n.max parameter indicates how many epidemic values to use to calculate the thresholds. A value of -1 indicates the program to use an appropriate number of points depending on the number
of seasons provided as input.

The `i.seasons` parameter indicates how many seasons are used for calculating thresholds. A value of -1 indicates the program to use as many as possible. If there are less than this parameter, the program used all seasons available.

Intensity thresholds and Epidemic threshold defines 5 levels of intensity:

1. Baseline level - Below epidemic threshold.
2. Low level - Above epidemic threshold and below low intensity threshold.
3. Medium level - Above low intensity threshold and below medium intensity threshold.
4. High level - Above medium intensity threshold and below high intensity threshold.
5. Very high level - Above high intensity threshold.

**Value**

`memintensity` returns a list with three objects, two of them are the parameters used (`param.levels` and `param.seasons`) and the third one (`intensity.thresholds`) is a matrix 1x4 with the epidemic and intensity thresholds.

1. Epidemic threshold.
2. Low intensity threshold.
3. Medium intensity threshold.
4. High intensity threshold.

**Author(s)**

Jose E. Lozano Alonso <lozanojo@jcyl.es>.

**References**


**Examples**

```r
## Castilla y Leon Influenza Rates data
data(flucyl)
## Finds the timing of the first season: 2001/2002
intensity<-memintensity(flucyl)
intensity
```
**memtrend**

Methods for influenza trend calculation

**Description**

Function `memtrend` is used to calculate the two parameters for defining the current influenza trend. This method is based on the Moving Epidemics Method (MEM) used to monitor influenza activity in a weekly surveillance system.

**Usage**

```r
memtrend(i.data, i.seasons = 10)
```

**Arguments**

- `i.data`: Data frame of input data.
- `i.seasons`: Maximum number of seasons to use.

**Details**

Input data is a data frame containing rates that represent historical influenza surveillance data. It can start and end at any given week (typically at week 40th), and rates can be expressed as per 100,000 inhabitants (or per consultations, if population is not available) or any other scale. The `i.seasons` parameter indicates how many seasons are used for calculating thresholds. A value of `-1` indicates the program to use as many as possible. If there are less than this parameter, the program used all seasons available.

There are three different states for trend, to determine the state, the current rate and the difference of the current and last weekly rate are needed:

- **Ascending** - When the weekly rate is above the epidemic threshold and the difference of the current and last weekly rate is higher than Delta OR this is the first time the rate is above the epidemic threshold.
- **Descending** - When the weekly rate is above the epidemic threshold and the difference of the current and last weekly rate is lower than Eta OR this is the first time the rate is below the epidemic threshold after having been above it.
- **Stable** - Otherwise.

**Value**

`memtrend` returns a list with two objects, the first one is the parameter used in the calculations (`param.seasons`) and the second one (`trend.thresholds`) is a matrix 1x2 with the Ascending (Delta) and Descending parameters (Eta).

```r
1 Delta - Ascending parameter.
2 Eta - Descending parameter.
```
Author(s)

Jose E. Lozano Alonso <lozalojo@jcyl.es>.

References


Examples

```r
## Castilla y Leon Influenza Rates data
data(flucyl)
## Finds the timing of the first season: 2001/2002
trend<-memtrend(flucyl)
trend
```
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