Package: NobBS (via r-universe)

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Title Nowcasting by Bayesian Smoothing

Version 1.1.1

Description A Bayesian approach to estimate the number of occurred-but-not-yet-reported cases from incomplete, time-stamped reporting data for disease outbreaks. 'NobBS' learns the reporting delay distribution and the time evolution of the epidemic curve to produce smoothed nowcasts in both stable and time-varying case reporting settings, as described in McGough et al. (2020) <doi:10.1371/journal.pcbi.1007735>.

Depends R (>= 3.3.0)

SystemRequirements JAGS (http://mcmc-jags.sourceforge.net/) for analysis of Bayesian hierarchical models

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RoxygenNote 7.3.2

Suggests knitr, rmarkdown, scoringutils (>= 2.0.0), ggplot2

VignetteBuilder knitr

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`denguedat` *denguedat: Dengue fever reporting data from Puerto Rico*

Description

Surveillance data from CDC Division of Vector-Borne Diseases. 1990-2010 case reporting data included. The first column, `onset_week`, indicates the week of symptom onset. The second column, `report_week`, indicates the week of case report. The third column, `gender`, indicates the gender of the infected individual (randomly assigned with 0.5:0.5 probability of "Male"/"Female"). This column may be used to produce stratified nowcasts using the function `NobBS.strat`.

Usage

```
data(denguedat)
```

Format

A data frame.

Examples

```
data(denguedat)
nowcast <- NobBS(denguedat, as.Date("1990-04-09"),units="1 week",onset_date="onset_week",
report_date="report_week")
nowcast$estimates
```

`mpoxdat` *mpoxdat: Mpox reporting data from the 2022 New York City Outbreak*

Description

Surveillance line list data provided by the New York City (NYC) Health Department at https://github.com/nychealth/mpox_no to accompany a nowcasting performance evaluation (doi: 10.2196/56495). Patients with a confirmed or probable mpox diagnosis or illness onset from July 8 through September 30, 2022 were included. The dataset contains 3323 rows and 4 columns. The first column, `dx_date`, is the specimen collection date of the first positive mpox laboratory result. The second column, `dx_report_date`, is the date the report of first positive mpox laboratory result was received by the NYC Health Department. The third column, `onset_date`, is the mpox symptom onset date. The fourth column, `onset_report_date`, is the date symptom onset date was received by the NYC Health Department.

Usage

```
data(mpoxdat)
```

Format

A data frame.

Examples

```
data(mpoxdat)
nowcast <- NobBS(mpoxdat, as.Date("2022-08-31"),units="1 day",onset_date="dx_date",
report_date="dx_report_date",moving_window=14)
nowcast$estimates
```

NobBS *Produce smooth Bayesian nowcasts of incomplete, time-stamped reporting data.*

Description

Nowcasting is useful to estimate the true number of cases when they are unknown or incomplete in the present because of reporting delays. 'NobBS' is a Bayesian nowcasting approach that learns from the reporting delay distribution as well as the temporal evolution of the epidemic curve to estimate the number of occurred but not yet reported cases for a given date.

Usage

```
NobBS(
  data,
  now,
  units,
  onset_date,
  report_date,
  moving_window = NULL,
  max_D = NULL,
  cutoff_D = NULL,
  add_dow_cov = FALSE,
  proportion_reported = 1,
  quiet = TRUE,
 specs = list(dist = c("Poisson", "NB"), alpha1.mean.prior = 0, alpha1.prec.prior =
  0.001, alphat.shape.prior = 0.001, alphat.rate.prior = 0.001, beta.priors = NULL,
  gamma.mean.prior = rep(0, 6), gamma.prec.prior = rep(0.25, 6), param_names = NULL,
  conf = 0.95, quantiles = c(0.025, 0.25, 0.5, 0.75, 0.975), dispersion.prior = NULL,
    nAdapt = 1000, nChains = 1, nBurnin = 1000, nThin = 1, nSamp = 10000)
)
```

Arguments

data	A time series of reporting data in line list format (one row per case), with a column onset_date indicating date of case onset, and a column report_date indicating date of case report.
now	An object of datatype Date indicating the date at which to perform the nowcast.
units	Time scale of reporting. Options: "1 day", "1 week".
onset_date	In quotations, the name of the column of datatype Date designating the date of case onset. e.g. "onset_week"
report_date	In quotations, the name of the column of datatype Date designating the date of case report. e.g. "report_week"
moving_window	Size of moving window for estimation of cases (numeric). The moving window size should be specified in the same date units as the reporting data (i.e. specify 7 to indicate 7 days, 7 weeks, etc). Default: NULL, i.e. takes all historical dates into consideration.
max_D	Maximum possible delay observed or considered for estimation of the delay distribution (numeric). Default: (length of unique dates in time series)-1 ; or, if a moving window is specified, (size of moving window)-1
cutoff_D	Consider only delays d<=max_D? Default: TRUE. If cutoff_D=TRUE, delays beyond max_D are ignored. If cutoff_D=FALSE, max_D is interpreted as delays>=max_D but within the moving window given by moving_window.
add_dow_cov	Whether or not to add day-of-week covariates to the model
proportion_reported	A decimal greater than 0 and less than or equal to 1 representing the proportion of all cases expected to be reported. Default: 1, e.g. 100 percent of all cases will eventually be reported. For asymptomatic diseases where not all cases will ever be reported, or for outbreaks in which severe under-reporting is expected, change this to less than 1.
quiet	Suppress all output and progress bars from the JAGS process. Default: TRUE.
specs	A list with arguments specifying the Bayesian model used: dist (Default: "Poisson"), beta.priors (Default: 0.1 for each delay d), nSamp (Default: 10000), nBurnin (Default: 1000), nAdapt (Default: 1000), nChains (Default: 1), nThin (Default: 1), alphat.shape.prior (Default: 0.001), alphat.rate.prior (Default: 0.001), alpha1.mean.prior (Default: 0), alpha1.prec.prior (Default: 0.001), gamma.mean.prior (Default: 0 for each day of the week (Monday-Saturday) - i.e. assuming initially no difference from Sunday), gamma.prec.prior (Default: 0.25 for each day of the week), dispersion.prior (Default: NULL, i.e. no dispersion. Otherwise, enter c(shape,rate) for a Gamma distribution.), conf (Default: 0.95), quantiles (Default: 5 quantiles for median, 50% PI and 95% PI), param_names (Default: NULL, i.e. output for all parameters is provided: c("lambda","alpha","beta.logged","tau2.alpha"). See McGough et al. 2019 (https://www.biorxiv.org/content/10.1101/663823v1) for detailed explanation of these parameters.).

Value

The function returns a list with the following elements: `estimates`, a 5-column data frame containing estimates for each date in the window of predictions (up to "now") with corresponding date of case onset, lower and upper bounds of the prediction interval, and the number of cases for that onset date reported up to 'now'. If quantiles is not NULL added columns will report the estimates for the requested quantiles; `estimates.inflated`, a Tx4 data frame containing estimates inflated by the proportion_reported for each date in the time series (up to "now") with corresponding date of case onset, lower and upper bounds of the prediction interval, and the number of cases for that onset date reported up to 'now'. If quantiles is not NULL added columns will report the inflated estimates for the requested quantiles; `nowcast.post.samples`, vector of 10,000 samples from the posterior predictive distribution of the nowcast, and `params.post`, a 10,000xN dataframe containing 10,000 posterior samples for the "N" parameters specified in specs[["param_names"]]. See McGough et al. 2019 (https://www.biorxiv.org/content/10.1101/663823v1) for detailed explanation of parameters.

Notes

'NobBS' requires that JAGS (Just Another Gibbs Sampler) is downloaded to the system. JAGS can be downloaded at <http://mcmc-jags.sourceforge.net/>.

Examples

```
# Load the data
data(denguedat)
# Perform default 'NobBS' assuming Poisson distribution, vague priors, and default specifications.
nowcast <- NobBS(denguedat, as.Date("1990-04-09"),units="1 week",onset_date="onset_week",
report_date="report_week")
nowcast$estimates
```

`NobBS.strat` *Stratified nowcasts of incomplete, time-stamped reporting data.*

Description

Produces nowcasts stratified by a single variable of interest, e.g. by geographic unit (province/state/region) or by age group.

Usage

```
NobBS.strat(
  data,
  now,
  units,
  onset_date,
  report_date,
  strata,
  moving_window = NULL,
  max_D = NULL,
```

```
  cutoff_D = NULL,
  add_dow_cov = FALSE,
  quiet = TRUE,
  proportion_reported = 1,
 specs = list(dist = c("Poisson", "NB"), alpha1.mean.prior = 0, alpha1.prec.prior =
  0.001, alphat.shape.prior = 0.001, alphat.rate.prior = 0.001, beta.priors = NULL,
  gamma.mean.prior = rep(0, 6), gamma.prec.prior = rep(0.25, 6), param_names = NULL,
  conf = 0.95, quantiles = c(0.025, 0.25, 0.5, 0.75, 0.975), dispersion.prior = NULL,
    nAdapt = 1000, nChains = 1, nBurnin = 1000, nThin = 1, nSamp = 10000)
)
```

Arguments

data	A time series of reporting data in line list format (one row per case), with a column onset_date indicating date of case onset, and a column report_date indicating date of case report.
now	An object of datatype Date indicating the date at which to perform the nowcast.
units	Time scale of reporting. Options: "1 day", "1 week".
onset_date	In quotations, the name of the column of datatype Date designating the date of case onset. e.g. "onset_week"
report_date	In quotations, the name of the column of datatype Date designating the date of case report. e.g. "report_week"
strata	In quotations, the name of the column indicating the stratifying variable.
moving_window	Size of moving window for estimation of cases (numeric). The moving window size should be specified in the same date units as the reporting data (i.e. specify 7 to indicate 7 days, 7 weeks, etc). Default: NULL, i.e. takes all historical dates into consideration.
max_D	Maximum possible delay observed or considered for estimation of the delay distribution (numeric). Default: (length of unique dates in time series)-1 ; or, if a moving window is specified, (size of moving window)-1
cutoff_D	Consider only delays d<=max_D? Default: TRUE. If cutoff_D=TRUE, delays beyond max_D are ignored. If cutoff_D=FALSE, max_D is interpreted as delays>=max_D but within the moving window given by moving_window.
add_dow_cov	Whether or not to add day-of-week covariates to the model
quiet	Suppress all output and progress bars from the JAGS process. Default: TRUE.
proportion_reported	A decimal greater than 0 and less than or equal to 1 representing the proportion of all cases expected to be reported. Default: 1, e.g. 100 percent of all cases will eventually be reported. For asymptomatic diseases where not all cases will ever be reported, or for outbreaks in which severe under-reporting is expected, change this to less than 1.
specs	A list with arguments specifying the Bayesian model used: dist (Default: "Poisson"), beta.priors (Default: 0.1 for each delay d), nSamp (Default: 10000), nBurnin (Default: 1000), nAdapt (Default: 1000), nChains (Default: 1), nThin (Default: 1), alphat.shape.prior (Default: 0.001), alphat.rate.prior (Default: 0.001), alpha1.mean.prior (Default: 0), alpha1.prec.prior (Default:

0.001), gamma.mean.prior (Default: 0 for each day of the week (Monday-Saturday) - i.e. assuming initially no difference from Sunday), gamma.prec.prior (Default: 0.25 for each day of the week), dispersion.prior (Default: NULL, i.e. no dispersion. Otherwise, enter c(shape,rate) for a Gamma distribution.), conf (Default: 0.95), quantiles (Default: 5 quantiles for median, 50% PI and 95% PI), param_names (Default: NULL, i.e. output for all parameters is provided: c("lambda","alpha","beta.logged","tau2.alpha"). See McGough et al. 2019 (https://www.biorxiv.org/content/10.1101/663823v1) for detailed explanation of these parameters.).

Value

The function returns a list with the following elements: estimates, a 5-column data frame containing estimates for each date in the window of predictions (up to "now") with corresponding date of case onset, lower and upper bounds of the prediction interval, and the number of cases for that onset date reported up to 'now'. If quantiles is not NULL added columns will report the estimates for the requested quantiles; estimates.inflated, a Tx4 data frame containing estimates inflated by the proportion_reported for each date in the time series (up to "now") with corresponding date of case onset, lower and upper bounds of the prediction interval, and the number of cases for that onset date reported up to 'now'. If quantiles is not NULL added columns will report the inflated estimates for the requested quantiles; nowcast.post.samples, vector of 10,000 samples from the posterior predictive distribution of the nowcast, and params.post, a 10,000xN dataframe containing 10,000 posterior samples for the "N" parameters specified in specs[["param_names"]]. See McGough et al. 2019 (https://www.biorxiv.org/content/10.1101/663823v1) for detailed explanation of parameters.

Notes

'NobBS' requires that JAGS (Just Another Gibbs Sampler) is downloaded to the system. JAGS can be downloaded at <http://mcmc-jags.sourceforge.net/>.

Examples

```
# Load the data
data(denguedat)
# Perform stratified 'NobBS' assuming Poisson distribution, vague priors, and default
# specifications.
nowcast <- NobBS.strat(denguedat, as.Date("1990-02-05"),units="1 week",onset_date="onset_week",
report_date="report_week",strata="gender")
nowcast$estimates
```

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