

Package ‘DRAFT’

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Type Package

Title Disease Rapid Analysis and Forecasting Tool

Version 0.3.0

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Description Fits epidemic data to and generates stochastic profiles of a model with constant or time-dependent behavior modification parameters. Two parameters, p and q , describe the effect of reduced contact rate of susceptible and infectious populations, respectively as described by Brauer (2011, ISSN:1471-2458). In the absence of behavior modification, $p=q=1$, we recover the familiar compartmental Susceptible-Infectious-Recovered (SIR) equations. 'DRAFT' supports both constant values for p and q and a time-dependent form which smoothly changes p and q from their initial, pre-epidemic value of 1.0 to the user chosen values that are between 0 and 1. The start and transient time of behavior change are set by the user. 'DRAFT' can be used to compare forecasts of epidemic incidence with and without behavior modification. Additional parameters and data fitting methods are explained in Ben-Nun et al (2019) <doi:10.1371/journal.pcbi.1007013>.

License GPL-3

Encoding UTF-8

LazyData true

NeedsCompilation yes

Imports stats, utils, tools, coda, gridExtra, ggplot2, reshape,
lubridate (>= 1.7.0)

RoxygenNote 6.1.1

Suggests knitr, rmarkdown

VignetteBuilder knitr

Repository CRAN

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incidence_data1	<i>Sample input data.frame for DRAFT::runbSEIR()</i>
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Description

Incidence data for San Diego County confirmed influenza cases from the 2017-2018 season.

Usage

```
data(incidence_data1)
```

Format

A data.frame with columns "date" and "cases". The "date" column is of class "Date" as expected by runbSEIR().

incidence_data2	<i>Sample input data.frame for DRAFT::runbSEIR()</i>
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Description

Incidence data for San Diego County confirmed influenza cases from the 2014-2015 season. Trailing rows of 'cases' column are NA indicating that a forecast is requested from DRAFT.

Usage

```
data(incidence_data2)
```

Format

A data.frame with columns "date" and "cases". The "date" column is of class "Date" as expected by runbSEIR().

incidence_data3	<i>Sample input data.frame for DRAFT::runbSEIR()</i>
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Description

Incidence data for Liberia ebola cases from the 2013 outbreak.

Usage

```
data(incidence_data3)
```

Format

A data.frame with columns "date" and "cases". The "date" column is of class "Date" as expected by runbSEIR().

incidence_data4	<i>Sample input data.frame for DRAFT::runbSEIR()</i>
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Description

Incidence data for Liberia ebola cases from the 2013 outbreak. Trailing rows of 'cases' column are NA indicating that a forecast is requested from DRAFT.

Usage

```
data(incidence_data4)
```

Format

A data.frame with columns "date" and "cases". The "date" column is of class "Date" as expected by runbSEIR().

runDRAFT

*Main driver for using DRAFT to fit user provided incidence data.***Description**

runDRAFT accepts a user provided incidence dataframe and uses that along with the user provided population and generation time, Tg, (and if relevant the latent period sigma) to fit the incidence data. Additionally, when specified by the user, runDRAFT will also generate a forecast for the incidence. Data cadence is arbitrary but at most can be monthly. We support S-I-R and S-E-I-R models for a single population with a fixed (non-time-dependent) force of infection.

Usage

```
runDRAFT(inc_data = NULL, out_dir = NULL, pop = 10000,
         epi_model = 1, Tg = 3, sigma = NULL, dp = NULL, dq = NULL,
         ts = NULL, dL = NULL, nMCMC = 10000, verbose = TRUE)
```

Arguments

inc_data	Dataframe containing incidence data. Must contain 'date' and 'cases' columns. The 'date' column must either be Date-class or convert to Date-class using <code>as.Date(inc_data\$date, format="%Y-%m-%d")</code> .
out_dir	Character string containing file path for output images and data files. If not specified, DRAFT will not generate output images or files.
pop	Integer population of the region for which incidence is provided
epi_model	- integer 1 (SIR), 2 (SEIR), 3 (SIR with behavior terms). Default is 1-SIR.
Tg	Numeric, generation time in days. Default is 3 days
sigma	inverse of of the latent period in days. Needed only for an SEIR model. Default NULL
dp	Proporiton of susceptible contact rate (0-1) following behavior modification. For example: If susceptibles reduce their contacts by 25%, set <code>dp=0.75</code> . Only used if inc_data requires a forecast.
dq	Proportion of infectious contact rate (0-1) following behavior modification. If infectious cases reduce their contacts by one half, set <code>dq=0.5</code> . Only used if inc_data requires a forecast.
ts	Date class. Start date of behavior modification.
dL	Number of days for behavior modification to completely take effect.
nMCMC	Number of steps to take in the Markov Chain Monte Carlo (MCMC) process. Number of steps needed for a good 'fit' will vary from case-to-case, but should never be less than $1e3$. It is recommended to start at $1e4$ and increase as needed.
verbose	This logical flag determines if code updates are printed to console/STDOUT during execution. It is recommended that verbose be set to TRUE for longer runs so the user may monitor progress.

Details

Data fitting is done using a Markov Chain Monte Carlo (MCMC) procedure. While generally discussed in the context of optimization, this procedure results in a mapping of the objective distribution. Thus the results of `runDRAFT()` come in the form of a distribution of parameters and the resulting distribution of incidence profiles.

Value

A list with the input and entire output of the run. List entries:

- *mydata*: A data structure containing the input data.
- *rtn*: The best-fit profile.
- *profile*: The full MCMC distribution of incidence profiles as a matrix.
- *tab*: The full MCMC distribution of parameters as a matrix.

Additional output is written to a subdirectory `'user_data_*`' within the current working directory. File list:

- *results-user_data-*.png*: This image shows the fit relative to the data as well as critical-parameter distributions.
- *user_data-incidence.png*: Incidence data plot.
- *mcmc-user_data-*.RData*: A list that includes the resulting MCMC parameter distributions.
- *profiles-user_data-*.RData*: A list that includes resulting distribution of incidence profiles.

Examples

```
# See examples vignette for a more in-depth walkthrough.
library(DRAFT)
vignette("DRAFT_examples")
# Run an SEIR model using the incidence file and assuming a
# population of 1 million people.
# The generation time and latent period are set to 2.6 days
# and 3 days respectively
head(incidence_data2)
temp_write = tempdir()
output <- runDRAFT(inc_data=incidence_data2, out_dir=temp_write,
  pop = 1e6, epi_model = 2, Tg = 2.6, sigma = 3.)

# Run an SIR model using the incidence file and assuming a
# population of 10,000 people.
# The generation time is set to 3 days. (No need to define
# a latent period.)
head(incidence_data1)
output <- runDRAFT(inc_data=incidence_data2, out_dir=temp_write,
  pop = 1e5, epi_model = 1, Tg = 3.)
```

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