

Package: serodynamics (via r-universe)

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Title Modeling Longitudinal Antibody Responses to Infection

Version 0.1.0

Description Implements Bayesian hierarchical models for estimating antibody kinetic parameters from longitudinal serological data. Fits two-phase within-host models capturing antibody rise, peak, and decay following pathogen infection, using 'JAGS' for posterior inference. Designed as the upstream companion to the 'serocalculator' package for end-to-end seroepidemiological analysis. Methods are described in Teunis and colleagues (2016) <[doi:10.1016/j.epidem.2016.04.001](https://doi.org/10.1016/j.epidem.2016.04.001)> and Teunis and van Eijkeren (2020) <[doi:10.1002/sim.8578](https://doi.org/10.1002/sim.8578)>.

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<https://ucd-serg.github.io/serodynamics/>

BugReports <https://github.com/UCD-SERG/serodynamics/issues>

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as_case_data	<i>Convert data into case_data</i>
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Description

Convert data into case_data

Usage

```
as_case_data(  
  data,  
  id_var = "index_id",  
  biomarker_var = "antigen_iso",  
  value_var = "value",  
  time_in_days = "timeindays"  
)
```

Arguments

data	a data.frame
id_var	a character string naming the column in data denoting participant ID
biomarker_var	a character string naming the column in data denoting which biomarker is being reported in value_var (e.g. "antigen_iso")
value_var	a character string naming the column in data with biomarker measurements
time_in_days	a character string naming the column in data with elapsed time since seroconversion

Value

a case_data object

Examples

```
set.seed(1)  
serocalculator::typhoid_curves_nostrat_100 |>  
  sim_case_data(n = 5) |>  
  as_case_data(  
    id_var = "id",  
    biomarker_var = "antigen_iso",  
    time_in_days = "timeindays",  
    value_var = "value"  
  )
```

autoplot.case_data *Plot case data*

Description

Plot case data

Usage

```
## S3 method for class 'case_data'
autoplot(object, log_y = TRUE, log_x = FALSE, ...)
```

Arguments

<code>object</code>	a <code>case_data</code> object
<code>log_y</code>	whether to log-transform the y-axis
<code>log_x</code>	whether to log-transform the x-axis
<code>...</code>	Arguments passed on to <code>ggplot2::geom_point</code> , <code>ggplot2::geom_line</code>

`mapping` Set of aesthetic mappings created by `aes()`. If specified and `inherit.aes = TRUE` (the default), it is combined with the default mapping at the top level of the plot. You must supply `mapping` if there is no plot mapping.

`data` The data to be displayed in this layer. There are three options:
 If `NULL`, the default, the data is inherited from the plot data as specified in the call to `ggplot()`.
 A `data.frame`, or other object, will override the plot data. All objects will be fortified to produce a data frame. See `fortify()` for which variables will be created.
 A function will be called with a single argument, the plot data. The return value must be a `data.frame`, and will be used as the layer data. A function can be created from a formula (e.g. `~ head(.x, 10)`).

`stat` The statistical transformation to use on the data for this layer. When using a `geom_*()` function to construct a layer, the `stat` argument can be used to override the default coupling between geoms and stats. The `stat` argument accepts the following:

- A `Stat` ggproto subclass, for example `StatCount`.
- A string naming the stat. To give the stat as a string, strip the function name of the `stat_` prefix. For example, to use `stat_count()`, give the stat as "count".
- For more information and other ways to specify the stat, see the [layer stat](#) documentation.

`position` A position adjustment to use on the data for this layer. This can be used in various ways, including to prevent overplotting and improving the display. The `position` argument accepts the following:

- The result of calling a position function, such as `position_jitter()`. This method allows for passing extra arguments to the position.

- A string naming the position adjustment. To give the position as a string, strip the function name of the `position_` prefix. For example, to use `position_jitter()`, give the position as "jitter".
- For more information and other ways to specify the position, see the [layer position](#) documentation.

`na.rm` If FALSE, the default, missing values are removed with a warning. If TRUE, missing values are silently removed.

`show.legend` logical. Should this layer be included in the legends? NA, the default, includes if any aesthetics are mapped. FALSE never includes, and TRUE always includes. It can also be a named logical vector to finely select the aesthetics to display. To include legend keys for all levels, even when no data exists, use TRUE. If NA, all levels are shown in legend, but unobserved levels are omitted.

`inherit.aes` If FALSE, overrides the default aesthetics, rather than combining with them. This is most useful for helper functions that define both data and aesthetics and shouldn't inherit behaviour from the default plot specification, e.g. `annotation_borders()`.

`arrow` Arrow specification, as created by `grid::arrow()`.

`arrow.fill` fill colour to use for the arrow head (if closed). NULL means use colour aesthetic.

`lineend` Line end style (round, butt, square).

`linejoin` Line join style (round, mitre, bevel).

`linemitre` Line mitre limit (number greater than 1).

`orientation` The orientation of the layer. The default (NA) automatically determines the orientation from the aesthetic mapping. In the rare event that this fails it can be given explicitly by setting orientation to either "x" or "y". See the *Orientation* section for more detail.

`direction` direction of stairs: 'vh' for vertical then horizontal, 'hv' for horizontal then vertical, or 'mid' for step half-way between adjacent x-values.

Value

a `ggplot2::ggplot`

Examples

```
set.seed(1)
sim_case_data <-
  serocalculator::typhoid_curves_nostrat_100 |>
  sim_case_data(n = 5, max_n_obs = 20, followup_interval = 14)

sim_case_data |>
  autoplot(alpha = .5)
```

initsfunction	<i>JAGS chain initialization function</i>
---------------	---

Description

JAGS chain initialization function

Usage

```
initsfunction(chain)
```

Arguments

chain an [integer](#) specifying which chain to initialize

Value

a [list](#) of RNG seeds and names

Examples

```
initsfunction(1)
```

load_data	<i>load and format data</i>
-----------	-----------------------------

Description

to add

Usage

```
load_data(  
  datapath = "inst/extdata/",  
  datafile = "TyphoidCaseData_github_09.30.21.csv"  
)
```

Arguments

datapath path to data folder
datafile data file name

Value

a `list` with the following elements:

- `smp1.t` = time since symptom/fever onset for each participant, max 7 visits
- `logy` = log antibody response at each time-point (max 7) for each of 7 biomarkers for each participant
- `ntest` is max number of biomarkers
- `nsmp1` = max number of samples per participant
- `nsubj` = number of study participants
- `ndim` = number of parameters to model(`y0`, `y1`, `t1`, `alpha`, `shape`)
- `my.hyp`, `prec.hyp`, `omega` and `wishdf` are all parameters to describe the shape of priors for (`y0`, `y1`, `t1`, `alpha`, `shape`)

 nepal_sees

SEES Typhoid data

Description

A subset of data from the SEES project highlighting Typhoid longitudinal data from Nepal.

Usage

nepal_sees

Format

nepal_sees:

A `base::data.frame()` with 904 rows and 8 columns:

Country Country name

person_id ID identifying a study participant

sample_id ID identifying sample taken

bldculres Pathogen participant tested positive for; Typhoid or paratyphoid

antigen_iso The antigen/antibody combination included in the assay

studyvisit Categorical estimated time frame for when sample was taken; 28 days, 3_months, 6_months, 12_months, baseline, or 18_months

daysincefeveronset Continuous measurement showing how exact days since symptom onset

result Continuous variable describing ELISA result

Source

reference study: [doi:10.1016/S26665247\(22\)001148](https://doi.org/10.1016/S26665247(22)001148)

nepal_sees_jags_output

SEES Typhoid run_mod jags output

Description

A `run_mod()` output using the `nepal_sees` example data set as input and stratifying by column "bldculres", which is the diagnosis type (typhoid or paratyphoid). Keeping only IDs "newperson", "sees_npl_1", "sees_npl_2".

Usage

```
nepal_sees_jags_output
```

Format

An S3 object of class `sr_model`: A `tibble::tbl_df` that contains the posterior predictive distribution of the person-specific parameters for a "new person" with no observed data (Subject = "newperson") and posterior distributions of the person-specific parameters for two arbitrarily-chosen subjects ("sees_npl_1" and "sees_npl_2"). Contains 40,000 rows, 7 columns, and model attributes.

Iteration Number of sampling iterations: 500 iterations

Chain Number of MCMC chains run: 2 chains run

Parameter Parameter being estimated

Iso_type Antibody/antigen type combination being evaluated: HlyE_IgA and HlyE_IgG

Stratification The variable used to stratify jags model: typhi and paratyphi

Subject ID of subject being evaluated: newperson, sees_npl_1, sees_npl_2

value Estimated value of the parameter

attributes A `list` of attributes that summarize the jags inputs, priors, and optional `jags_post_mcmc` object

Source

reference study: [doi:10.1016/S26665247\(22\)001148](https://doi.org/10.1016/S26665247(22)001148)

plot_jags_dens	Density Plot Diagnostics
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Description

plot_jags_dens() takes a [list](#) output from [run_mod\(\)](#) to create density plots for each chain run in the mcmc estimation. Defaults will produce every combination of antigen/antibody, parameters, and stratifications, unless otherwise specified. Antigen/antibody combinations and stratifications will vary by analysis. The antibody dynamic curve includes the following parameters:

- y0 = baseline antibody concentration
- y1 = peak antibody concentration
- t1 = time to peak
- r = shape parameter
- alpha = decay rate

Usage

```
plot_jags_dens(  
  data,  
  iso = unique(data$Iso_type),  
  param = unique(data$Parameter),  
  strat = unique(data$Stratification)  
)
```

Arguments

data	A list outputted from run_mod() .
iso	Specify character string to produce plots of only a specific antigen/antibody combination, entered with quotes. Default outputs all antigen/antibody combinations.
param	Specify character string to produce plots of only a specific parameter, entered with quotes. Options include: <ul style="list-style-type: none">• alpha = posterior estimate of decay rate• r = posterior estimate of shape parameter• t1 = posterior estimate of time to peak• y0 = posterior estimate of baseline antibody concentration• y1 = posterior estimate of peak antibody concentration
strat	Specify character string to produce plots of specific stratification entered in quotes.

Value

A [base::list\(\)](#) of [ggplot2::ggplot\(\)](#) objects producing density plots for all the specified input.

Author(s)

Sam Schildhauer

Examples

```
data <- serodynamics::nepal_sees_jags_output

# Specifying isotype and stratification for traceplot.
plot_jags_dens(
  data = data,
  iso = "HlyE_IgA",
  strat = "typhi")
```

plot_jags_effect

*Plot Effective Sample Size Diagnostics***Description**

plot_jags_effect() takes a [list](#) output from [run_mod\(\)](#) to create summary diagnostics for each chain run in the mcmc estimation. Defaults will produce every combination of antigen/antibody, parameters, and stratifications, unless otherwise specified. At least 2 chains are required to run function. Antigen/antibody combinations and stratifications will vary by analysis. The antibody dynamic curve includes the following parameters:

- y0 = baseline antibody concentration
- y1 = peak antibody concentration
- t1 = time to peak
- r = shape parameter
- alpha = decay rate

Usage

```
plot_jags_effect(
  data,
  iso = unique(data$Iso_type),
  param = unique(data$Parameter),
  strat = unique(data$Stratification)
)
```

Arguments

data	A list outputted from run_mod().
iso	Specify character string to produce plots of only a specific antigen/antibody combination, entered with quotes. Default outputs all antigen/antibody combinations.

param	Specify character string to produce plots of only a specific parameter, entered with quotes. Options include: <ul style="list-style-type: none"> • y_0 = posterior estimate of baseline antibody concentration • y_1 = posterior estimate of peak antibody concentration • t_1 = posterior estimate of time to peak • r = posterior estimate of shape parameter • α = posterior estimate of decay rate
strat	Specify character string to produce plots of specific stratification entered in quotes.

Value

A [list](#) of [ggplot2::ggplot](#) objects showing the proportion of effective samples taken/total samples taken for all parameter iso combinations. The estimate with the highest proportion of effective samples taken will be listed first.

Author(s)

Sam Schildhauer

Examples

```
data <- serodynamics::nepal_sees_jags_output

plot_jags_effect(data = data,
                 iso = "HlyE_IgA",
                 strat = "typhi")
```

plot_jags_Rhat	<i>Rhat Plot Diagnostics</i>
----------------	------------------------------

Description

plot_jags_Rhat() takes a [list](#) output from [run_mod\(\)](#) to produce dotplots of potential scale reduction factors (Rhat) for each chain run in the mcmc estimation. Rhat values analyze the spread of chains compared to pooled values with a goal of observing $rhat < 1.10$ for convergence. Defaults will produce every combination of antigen/antibody, parameters, and stratifications, unless otherwise specified. Antigen/antibody combinations and stratifications will vary by analysis. The antibody dynamic curve includes the following parameters:

- y_0 = baseline antibody concentration
- y_1 = peak antibody concentration
- t_1 = time to peak
- r = shape parameter
- α = decay rate

Usage

```
plot_jags_Rhat(  
  data,  
  iso = unique(data$Iso_type),  
  param = unique(data$Parameter),  
  strat = unique(data$Stratification)  
)
```

Arguments

data	A list outputted from run_mod().
iso	Specify character string to produce plots of only a specific antigen/antibody combination, entered with quotes. Default outputs all antigen/antibody combinations.
param	Specify character string to produce plots of only a specific parameter, entered with quotes. Options include: <ul style="list-style-type: none">• y_0 = posterior estimate of baseline antibody concentration• y_1 = posterior estimate of peak antibody concentration• t_1 = posterior estimate of time to peak• r = posterior estimate of shape parameter• α = posterior estimate of decay rate
strat	Specify character string to produce plots of specific stratification entered in quotes.

Value

A [list](#) of [ggplot2::ggplot](#) objects producing dotplots with rhat values for all the specified input.

Author(s)

Sam Schildhauer

Examples

```
data <- serodynamics::nepal_sees_jags_output  
  
plot_jags_Rhat(data = data,  
               iso = "HlyE_IgA",  
               strat = "typhi")
```

Description

plot_jags_trace() takes a [list](#) output from [run_mod\(\)](#) to create trace plots for each chain run in the mcmc estimation. Defaults will produce every combination of antigen/antibody, parameters, and stratifications, unless otherwise specified. Antigen/antibody combinations and stratifications will vary by analysis. The antibody dynamic curve includes the following parameters:

- y0 = baseline antibody concentration
- y1 = peak antibody concentration
- t1 = time to peak
- r = shape parameter
- alpha = decay rate

Usage

```
plot_jags_trace(  
  data,  
  iso = unique(data$Iso_type),  
  param = unique(data$Parameter),  
  strat = unique(data$Stratification)  
)
```

Arguments

data	A list outputted from run_mod() .
iso	Specify character string to produce plots of only a specific antigen/antibody combination, entered with quotes. Default outputs all antigen/antibody combinations.
param	Specify character string to produce plots of only a specific parameter, entered with quotes. Options include: <ul style="list-style-type: none">• alpha = posterior estimate of decay rate• r = posterior estimate of shape parameter• t1 = posterior estimate of time to peak• y0 = posterior estimate of baseline antibody concentration• y1 = posterior estimate of peak antibody concentration
strat	Specify character string to produce plots of specific stratification entered in quotes.

Value

A [list](#) of [ggplot2::ggplot](#) objects producing trace plots for all the specified input.

Author(s)

Sam Schildhauer

Examples

```
data <- serodynamics::nepal_sees_jags_output

# Specifying isotype, parameter, and stratification for traceplot.
plot_jags_trace(
  data = data,
  iso = "HlyE_IgA",
  strat = "typhi")
```

plot_predicted_curve *Generate Predicted Antibody Response Curves (Median + 95% CI)*

Description

Plots a median antibody response curve with a 95% credible interval ribbon, using MCMC samples from the posterior distribution. Optionally overlays observed data, applies logarithmic spacing on the y- and x-axes, and shows all individual sampled curves.

Usage

```
plot_predicted_curve(
  model,
  ids,
  antigen_iso,
  dataset = NULL,
  legend_obs = "Observed data",
  legend_median = "Median prediction",
  show_quantiles = TRUE,
  log_y = FALSE,
  log_x = FALSE,
  show_all_curves = FALSE,
  alpha_samples = 0.3,
  xlim = NULL,
  ylab = NULL,
  facet_by_id = length(ids) > 1,
  ncol = NULL
)
```

Arguments

model	An <code>sr_model</code> object (returned by <code>run_mod()</code>) containing samples from the posterior distribution of the model parameters.
ids	The participant IDs to plot; for example, "sees_np1_128".

antigen_iso	The antigen isotype to plot; for example, "HlyE_IgA" or "HlyE_IgG".
dataset	(Optional) A <code>tibble::tbl_df</code> with observed antibody response data. Must contain: <ul style="list-style-type: none"> • timeindays • value • id • antigen_iso
legend_obs	Label for observed data in the legend.
legend_median	Label for the median prediction line.
show_quantiles	<code>logical</code> ; if <code>TRUE</code> (default), plots the 2.5%, 50%, and 97.5% quantiles.
log_y	<code>logical</code> ; if <code>TRUE</code> , applies a <code>log10</code> transformation to the y-axis.
log_x	<code>logical</code> ; if <code>TRUE</code> , applies a <code>log10</code> transformation to the x-axis.
show_all_curves	<code>logical</code> ; if <code>TRUE</code> , overlays all individual sampled curves.
alpha_samples	Numeric; transparency level for individual curves (default = 0.3).
xlim	(Optional) A numeric vector of length 2 providing custom x-axis limits.
ylab	(Optional) A string for the y-axis label. If <code>NULL</code> (default), the label is automatically set to "ELISA units" or "ELISA units (log scale)" based on the <code>log_y</code> argument.
facet_by_id	<code>logical</code> ; if <code>TRUE</code> , facets the plot by 'id'. Defaults to <code>TRUE</code> when multiple IDs are provided.
ncol	<code>integer</code> ; number of columns for faceting.

Value

A `ggplot2::ggplot` object displaying predicted antibody response curves with a median curve and a 95% credible interval band as default.

Examples

```
sees_model <- serodynamics::nepal_sees_jags_output |>
  dplyr::filter(Iteration <= 50) # use 50 of 500 iterations for faster examples
sees_data <- serodynamics::nepal_sees

# Plot (linear axes) with all individual curves + median ribbon
p1 <- plot_predicted_curve(
  model      = sees_model,
  dataset    = sees_data,
  ids        = "sees_npl_128",
  antigen_iso = "HlyE_IgA",
  show_quantiles = TRUE,
  log_y      = FALSE,
  log_x      = FALSE,
  show_all_curves = TRUE
)
print(p1)
```

```

# Plot (log10 y-axis) with all individual curves + median ribbon
p2 <- plot_predicted_curve(
  model          = sees_model,
  dataset        = sees_data,
  ids            = "sees_npl_128",
  antigen_iso    = "HlyE_IgA",
  show_quantiles = TRUE,
  log_y          = TRUE,
  log_x          = FALSE,
  show_all_curves = TRUE
)
print(p2)

# Plot with custom x-axis limits (0-600 days)
p3 <- plot_predicted_curve(
  model          = sees_model,
  dataset        = sees_data,
  ids            = "sees_npl_128",
  antigen_iso    = "HlyE_IgA",
  show_quantiles = TRUE,
  log_y          = FALSE,
  log_x          = FALSE,
  show_all_curves = TRUE,
  xlim           = c(0, 600)
)
print(p3)

# Multi-ID, faceted plot (single antigen):
p4 <- plot_predicted_curve(
  model          = sees_model,
  dataset        = sees_data,
  ids            = c("sees_npl_128", "sees_npl_131"),
  antigen_iso    = "HlyE_IgA",
  show_all_curves = TRUE,
  facet_by_id    = TRUE
)
print(p4)

```

post_summ

Summary Table of Jags Posterior Estimates

Description

post_summ() takes a [list](#) output from [run_mod\(\)](#) to summary table for parameter, antigen/antibody, and stratification combination. Defaults will produce every combination of antigen/antibody, parameters, and stratifications, unless otherwise specified. Antigen/antibody combinations and stratifications will vary by analysis. The antibody dynamic curve includes the following parameters:

- y0 = baseline antibody concentration
- y1 = peak antibody concentration

- t1 = time to peak
- r = shape parameter
- alpha = decay rate

Usage

```
post_summ(  
  data,  
  iso = unique(data$Iso_type),  
  param = unique(data$Parameter),  
  strat = unique(data$Stratification)  
)
```

Arguments

data	A list outputted from <code>run_mod()</code> .
iso	Specify character string to produce tables of only a specific antigen/antibody combination, entered with quotes. Default outputs all antigen/antibody combinations.
param	Specify character string to produce tables of only a specific parameter, entered with quotes. Options include: <ul style="list-style-type: none">• alpha = posterior estimate of decay rate• r = posterior estimate of shape parameter• t1 = posterior estimate of time to peak• y_0 = posterior estimate of baseline antibody concentration• y_1 = posterior estimate of peak antibody concentration
strat	Specify character string to produce tables of specific stratification entered in quotes.

Value

A [data.frame](#) summarizing estimate mean, standard deviation (SD), median, and quantiles (2.5%, 25.0%, 50.0%, 75.0%, 97.5%).

Author(s)

Sam Schildhauer

Examples

```
post_summ(data = serodynamics::nepal_sees_jags_output)
```

 postprocess_jags_output

Postprocess JAGS output

Description

Postprocess JAGS output

Usage

```
postprocess_jags_output(jags_output, ids, antigen_isos)
```

Arguments

jags_output	output from <code>runjags::run.jags()</code>
ids	IDs of individuals being sampled (JAGS discards this information, so it has to be re-attached)
antigen_isos	names of biomarkers being modeled (JAGS discards this information, so it has to be re-attached)

Value

a `tibble::tbl_df`

Examples

```
set.seed(1)
raw_data <-
  serocalculator::typhoid_curves_nostrat_100 |>
  dplyr::filter(
    antigen_iso |> stringr::str_starts(pattern = "HlyE")
  ) |>
  sim_case_data(
    n = 5,
    antigen_isos = c("HlyE-IgA", "HlyE-IgG")
  )
prepped_data <- prep_data(raw_data)
priors <- prep_priors(max_antigens = prepped_data$n_antigen_isos)
nchains <- 2
# nr of MC chains to run simultaneously
nadapt <- 100
# nr of iterations for adaptation
nburnin <- 100
# nr of iterations to use for burn-in
nmc <- 100
# nr of samples in posterior chains
niter <- 100
# nr of iterations for posterior sample
```

```

nthin <- round(niter / nmc)
# thinning needed to produce nmc from niter

tomonitor <- c("y0", "y1", "t1", "alpha", "shape")

file_mod <- serodynamics_example("model.jags")

set.seed(11325)
jags_post <- runjags::run.jags(
  model = file_mod,
  data = c(prepped_data, priors),
  inits = initsfunction,
  method = "parallel",
  adapt = nadapt,
  burnin = nburnin,
  thin = nthin,
  sample = nmc,
  n.chains = nchains,
  monitor = tomonitor,
  summarise = FALSE
)

curve_params <- jags_post |> postprocess_jags_output(
  ids = attr(prepped_data, "ids"),
  antigen_isos = attr(prepped_data, "antigens")
)

print(curve_params)

```

```
prep_data
```

```
prepare data for JAGs
```

Description

prepare data for JAGs

Usage

```

prep_data(
  dataframe,
  biomarker_column = get_biomarker_names_var(dataframe),
  verbose = FALSE,
  add_newperson = TRUE
)

```

Arguments

`dataframe` a [data.frame](#) containing ...

`biomarker_column` [character](#) string indicating which column contains antigen-isotype names

verbose whether to produce verbose messaging
 add_newperson whether to add an extra record with missing data

Value

a `prepped_jags_data` object (a [list](#) with extra attributes ...)

Examples

```
set.seed(1)
raw_data <-
  serocalculator::typhoid_curves_nostrat_100 |>
  sim_case_data(n = 5)
prepped_data <- prep_data(raw_data)
```

prep_priors	<i>Prepare priors</i>
-------------	-----------------------

Description

Takes multiple [vector](#) inputs to allow for modifiable priors. Priors can be specified as an option in `run_mod`.

Usage

```
prep_priors(
  max_antigens,
  mu_hyp_param = c(1, 7, 1, -4, -1),
  prec_hyp_param = c(1, 1e-05, 1, 0.001, 1),
  omega_param = c(1, 50, 1, 10, 1),
  wishdf_param = 20,
  prec_logy_hyp_param = c(4, 1)
)
```

Arguments

`max_antigens` An [integer](#) specifying how many antigen-isotypes (biomarkers) will be modeled.

`mu_hyp_param` A [numeric vector](#) of 5 values representing the prior mean for the population level parameters parameters (`y0`, `y1`, `t1`, `r`, `alpha`) for each biomarker. If specified, must be 5 values long, representing the following parameters:

- `y0` = baseline antibody concentration (default = 1.0)
- `y1` = peak antibody concentration (default = 7.0)
- `t1` = time to peak (default = 1.0)
- `r` = shape parameter (default = -4.0)
- `alpha` = decay rate (default = -1.0)

- `prec_hyp_param` A **numeric vector** of 5 values corresponding to hyperprior diagonal entries for the precision matrix (i.e. inverse variance) representing prior covariance of uncertainty around `mu_hyp_param`. If specified, must be 5 values long:
- defaults: $y_0 = 1.0$, $y_1 = 0.00001$, $t_1 = 1.0$, $r = 0.001$, $\alpha = 1.0$
- `omega_param` A **numeric vector** of 5 values corresponding to the diagonal entries representing the Wishart hyperprior distributions of `prec_hyp_param`, describing how much we expect parameters to vary between individuals. If specified, must be 5 values long:
- defaults: $y_0 = 1.0$, $y_1 = 50.0$, $t_1 = 1.0$, $r = 10.0$, $\alpha = 1.0$
- `wishdf_param` An **integer vector** of 1 value specifying the degrees of freedom for the Wishart hyperprior distribution of `prec_hyp_param`. If specified, must be 1 value long:
- default = 20.0
 - The value of `wishdf_param` controls how informative the Wishart prior is. Higher values lead to tighter priors on individual variation. Lower values (e.g., 5–10) make the prior more weakly informative, which can help improve convergence if the model is over-regularized.
- `prec_logy_hyp_param` A **numeric vector** of 2 values corresponding to hyperprior diagonal entries on the log-scale for the precision matrix (i.e. inverse variance) representing prior beliefs of individual variation. If specified, must be 2 values long:
- defaults = 4.0, 1.0

Value

A "curve_params_priors" object (a subclass of **list** with the inputs to `prep_priors()` attached as **attributes** entry named "used_priors"), containing the following elements:

- "n_params": Corresponds to the 5 parameters being estimated.
- "mu.hyp": A **matrix** of hyperpriors with dimensions `max_antigens` x 5 (# of parameters), representing the mean of the hyperprior distribution for the five seroresponse parameters: y_0 , y_1 , t_1 , r , and α).
- "prec.hyp": A three-dimensional **numeric array** with dimensions `max_antigens` x 5 (# of parameters), containing the precision matrices of the hyperprior distributions of `mu.hyp`, for each biomarker.
- "omega": A three-dimensional **numeric array** with 5 **matrix**, each with dimensions `max_antigens` x 5 (# of parameters), representing the precision matrix of Wishart hyper-priors for `prec.hyp`.
- "wishdf": A **vector** of 2 values specifying the degrees of freedom for the Wishart distribution used in the subject-level precision prior.
- "prec.logy.hyp": A **matrix** of hyper-parameters for the precision (inverse variance) of individual variation measuring `max_antigens` x 2, on the log-scale.
- `used_priors` = inputs to `prep_priors()` attached as **attributes**.

Examples

```

prep_priors(max_antigens = 2,
            mu_hyp_param = c(1.0, 7.0, 1.0, -4.0, -1.0),
            prec_hyp_param = c(1.0, 0.00001, 1.0, 0.001, 1.0),
            omega_param = c(1.0, 50.0, 1.0, 10.0, 1.0),
            wishdf_param = 20,
            prec_logy_hyp_param = c(4.0, 1.0))

prep_priors(max_antigens = 2)

```

run_mod

Run Jags Model

Description

run_mod() takes a data frame and adjustable MCMC inputs to `runjags::run.jags()` as an MCMC Bayesian model to estimate antibody dynamic curve parameters. The `rjags::jags.model()` models seroresponse dynamics to an infection. The antibody dynamic curve includes the following parameters:

- y0 = baseline antibody concentration
- y1 = peak antibody concentration
- t1 = time to peak
- shape = shape parameter
- alpha = decay rate

Usage

```

run_mod(
  data,
  file_mod = serodynamics_example("model.jags"),
  nchain = 4,
  nadapt = 0,
  nburn = 0,
  nmc = 100,
  niter = 100,
  strat = NA,
  with_post = FALSE,
  ...
)

```

Arguments

`data` A `base::data.frame()` with the following columns.

`file_mod` The name of the file that contains model structure.

nchain	An integer between 1 and 4 that specifies the number of MCMC chains to be run per jags model.
nadapt	An integer specifying the number of adaptations per chain.
nburn	An integer specifying the number of burn ins before sampling.
nmc	An integer specifying the number of samples in posterior chains.
niter	An integer specifying the number of iterations.
strat	A character string specifying the stratification variable, entered in quotes.
with_post	A logical value specifying whether a raw <code>jags.post</code> component should be included as an element of the <code>list</code> object returned by <code>run_mod()</code> (see <code>Value</code> section below for details). Note: These objects can be large.
...	Arguments passed on to prep_priors
max_antigens	An integer specifying how many antigen-isotypes (biomarkers) will be modeled.
mu_hyp_param	A numeric vector of 5 values representing the prior mean for the population level parameters parameters (<code>y0</code> , <code>y1</code> , <code>t1</code> , <code>r</code> , <code>alpha</code>) for each biomarker. If specified, must be 5 values long, representing the following parameters: <ul style="list-style-type: none"> • <code>y0</code> = baseline antibody concentration (default = 1.0) • <code>y1</code> = peak antibody concentration (default = 7.0) • <code>t1</code> = time to peak (default = 1.0) • <code>r</code> = shape parameter (default = -4.0) • <code>alpha</code> = decay rate (default = -1.0)
prec_hyp_param	A numeric vector of 5 values corresponding to hyperprior diagonal entries for the precision matrix (i.e. inverse variance) representing prior covariance of uncertainty around <code>mu_hyp_param</code> . If specified, must be 5 values long: <ul style="list-style-type: none"> • defaults: <code>y0</code> = 1.0, <code>y1</code> = 0.00001, <code>t1</code> = 1.0, <code>r</code> = 0.001, <code>alpha</code> = 1.0
omega_param	A numeric vector of 5 values corresponding to the diagonal entries representing the Wishart hyperprior distributions of <code>prec_hyp_param</code> , describing how much we expect parameters to vary between individuals. If specified, must be 5 values long: <ul style="list-style-type: none"> • defaults: <code>y0</code> = 1.0, <code>y1</code> = 50.0, <code>t1</code> = 1.0, <code>r</code> = 10.0, <code>alpha</code> = 1.0
wishdf_param	An integer vector of 1 value specifying the degrees of freedom for the Wishart hyperprior distribution of <code>prec_hyp_param</code> . If specified, must be 1 value long. <ul style="list-style-type: none"> • default = 20.0 • The value of <code>wishdf_param</code> controls how informative the Wishart prior is. Higher values lead to tighter priors on individual variation. Lower values (e.g., 5–10) make the prior more weakly informative, which can help improve convergence if the model is over-regularized.
prec_logy_hyp_param	A numeric vector of 2 values corresponding to hyperprior diagonal entries on the log-scale for the precision matrix (i.e. inverse variance) representing prior beliefs of individual variation. If specified, must be 2 values long: <ul style="list-style-type: none"> • defaults = 4.0, 1.0

Value

An `sr_model` class object: a subclass of `tibble::tbl_df` that contains MCMC samples from the joint posterior distribution of the model parameters, conditional on the provided input data, including the following:

- `iteration` = Number of sampling iterations
- `chain` = Number of MCMC chains run; between 1 and 4
- `Parameter` = Parameter being estimated. Includes the following:
 - `y0` = Posterior estimate of baseline antibody concentration
 - `y1` = Posterior estimate of peak antibody concentration
 - `t1` = Posterior estimate of time to peak
 - `shape` = Posterior estimate of shape parameter
 - `alpha` = Posterior estimate of decay rate
- `Iso_type` = Antibody/antigen type combination being evaluated
- `Stratification` = The variable used to stratify jags model
- `Subject` = ID of subject being evaluated
- `value` = Estimated value of the parameter
- The following [attributes](#) are included in the output:
 - `class`: Class of the output object.
 - `nChain`: Number of chains run.
 - `nParameters`: The amount of parameters estimated in the model.
 - `nIterations`: Number of iteration specified.
 - `nBurnin`: Number of burn ins.
 - `nThin`: Thinning number (`niter/nmc`).
 - `priors`: A [list](#) that summarizes the input priors, including:
 - * `mu_hyp_param`
 - * `prec_hyp_param`
 - * `omega_param`
 - * `wishdf`
 - * `prec_logy_hyp_param`
 - `fitted_residuals`: A [data.frame](#) containing fitted and residual values for all observations.
 - An optional `"jags.post"` attribute, included when argument `with_post = TRUE`.

Author(s)

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Examples

```
data(nepal_sees_jags_output, package = "serodynamics")
post_summ(nepal_sees_jags_output)

if (interactive() && !is.element(runjags::findjags(), c("", NULL))) {
```

```
set.seed(1)
strat1 <- serocalculator::typhoid_curves_nostrat_100 |>
  sim_case_data(n = 100) |>
  dplyr::mutate(strat = "stratum 2")
strat2 <- serocalculator::typhoid_curves_nostrat_100 |>
  sim_case_data(n = 100) |>
  dplyr::mutate(strat = "stratum 1")

dataset <- dplyr::bind_rows(strat1, strat2)

fitted_model <- run_mod(
  data = dataset, # The data set input
  file_mod = serodynamics_example("model.jags"),
  nchain = 4, # Number of mcmc chains to run
  nadapt = 100, # Number of adaptations to run
  nburn = 100, # Number of unrecorded samples before sampling begins
  nmc = 1000,
  niter = 2000, # Number of iterations
  strat = "strat"
) # Variable to be stratified
}
```

serodynamics_example *Get path to an example file*

Description

The [serodynamics](#) package comes bundled with a number of sample files in its `inst/extdata` directory. This `serodynamics_example()` function make those sample files easy to access.

Usage

```
serodynamics_example(file = NULL)
```

Arguments

`file` Name of file. If `NULL`, the example files will be listed.

Details

Adapted from `readr::readr_example()` following the guidance in <https://r-pkgs.org/data.html#sec-data-example-path-helper>.

Value

a [character](#) string providing the path to the file specified by `file`, or a vector of available files if `file = NULL`.

Examples

```
serodynamics_example()
serodynamics_example(
  "SEES_Case_Nepal_ForSeroKinetics_02-13-2025.csv")
```

sim_case_data	<i>Simulate longitudinal case follow-up data from a homogeneous population</i>
---------------	--

Description

Simulate longitudinal case follow-up data from a homogeneous population

Usage

```
sim_case_data(
  n,
  curve_params,
  antigen_isos = get_biomarker_levels(curve_params),
  max_n_obs = 10,
  dist_n_obs = tibble::tibble(n_obs = 1:max_n_obs, prob = 1/max_n_obs),
  followup_interval = 7,
  followup_variance = 1
)
```

Arguments

n	integer number of cases to simulate
curve_params	a curve_params object from <code>serocalculator::as_curve_params</code> , assumed to be unstratified
antigen_isos	character vector : which antigen isotypes to simulate
max_n_obs	maximum number of observations
dist_n_obs	distribution of number of observations (<code>tibble::tbl_df</code>)
followup_interval	integer
followup_variance	integer

Value

a case_data object

Examples

```
set.seed(1)
serocalculator::typhoid_curves_nostrat_100 |>
  sim_case_data(n = 100)
```

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