

# Package: autoSTK (via r-universe)

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**Type** Package

**Title** Automatic Spatio-Temporal Kriging

**Version** 2.1.2

**Description** Automatic spatio-temporal Kriging extending the automap package (Hiemstra et al. 2010). Provides automatic variogram model fitting with data-driven initial parameter estimation (practical-range based) and multiple optimisers: L-BFGS-B with multi-start, LHS grid search, Simulated Annealing (SANN), and Genetic Algorithm (via the GA package or built-in Differential Evolution fallback). Covariance structure selection via AIC/BIC or cross-validation, and spatiotemporal prediction via gstat. Input classes sf, sftime, spacetime ST\*DF, and cubble are all supported. Four cross-validation strategies for spatiotemporal data are implemented.

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**Encoding** UTF-8

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autofitVariogramST      *Automatic Spatio-Temporal Variogram Fitting*

---

## Description

Fits a spatio-temporal variogram model to a spatio-temporal data frame using automatic parameter estimation. Supports multiple optimisers and objective functions (v2.0+).

**Usage**

```

autofitVariogramST(
  stf,
  formula,
  typestv = "sumMetric",
  candidate_model = c("Ste", "Exc", "Exp", "Wav"),
  guess_nugget = NULL,
  guess_p sill = NULL,
  tlags = 0:6,
  cutoff = 20000,
  width = 500,
  aniso_method = "vgm",
  type_joint = "Exp",
  prodsum_k = NULL,
  surface = FALSE,
  measurement_error = c(0, 0, 0),
  cores = 1L,
  verbose = FALSE,
  optimizer = c("lbfgsb", "grid", "sa", "ga"),
  objective = c("WLS", "MLE"),
  n_restart = 1L,
  optimizer_control = list()
)

```

**Arguments**

<code>stf</code>	A spatio-temporal data frame (STFDF, STSDF, STIDF, or sftime).
<code>formula</code>	A formula specifying the response and explanatory variables.
<code>typestv</code>	Character. ST variogram model type. One of "sumMetric", "separable", "productSum", "productSumOld", "simpleSumMetric", "metric".
<code>candidate_model</code>	Character vector of candidate spatial/temporal variogram model families (e.g. c("Ste", "Exc", "Exp", "Wav")).
<code>guess_nugget</code>	Optional initial guess for the nugget. Estimated if NULL.
<code>guess_p sill</code>	Optional initial guess for the partial sill. Estimated if NULL.
<code>tlags</code>	Integer vector of temporal lags.
<code>cutoff</code>	Numeric. Maximum spatial lag distance.
<code>width</code>	Numeric. Width of spatial lag bins.
<code>aniso_method</code>	Character. Method for estimating ST anisotropy ratio ("vgm" or "linear").
<code>type_joint</code>	Character. Model family for the joint variogram component.
<code>prodsum_k</code>	Numeric. k parameter for productSum models.
<code>surface</code>	Logical. If TRUE, also compute and return the variogram surface.
<code>measurement_error</code>	Numeric vector of length 3: spatial, temporal, joint.

cores	Integer. Number of cores for variogramST.
verbose	Logical. If TRUE, print diagnostic messages.
optimizer	Character. Optimisation strategy: "lbfgsb" (default - multi-start L-BFGS-B), "grid" (LHS grid search + L-BFGS-B refinement), "sa" (simulated annealing via <code>optim(method = "SANN")</code> ), or "ga" (genetic algorithm via the <b>GA</b> package).
objective	Character. Fitting criterion: "WLS" (weighted least squares, default) or "MLE" (Gaussian log-likelihood; only for $n < 500$ ).
n_restart	Integer. Number of optimisation restarts for optimizer = "lbfgsb". Default 1 matches v1.x behaviour.
optimizer_control	Named list of extra arguments forwarded to the optimiser. Recognised keys differ by optimiser: "lbfgsb" maxit (default 2500). "grid" n_coarse (default 50), n_refine (default 30), maxit (default 2500). "sa" maxit (default 5000), temp (initial temperature, default 10), tmax (steps before cooling, default 10). "ga" popSize (default 50), maxiter (default 200), run (early-stopping generations without improvement, default 30), seed (default 42).

### Value

A STVariogramFit object (list) with elements:

- jointSTV** Fitted ST variogram model.
- empSTV** Empirical ST variogram.
- SpV** Fitted spatial marginal variogram.
- TV** Fitted temporal marginal variogram.
- STVsurface** (Optional) Variogram surface if surface = TRUE.
- optimizer** Character. Optimiser used.
- objective** Character. Objective function used.
- loglik** Numeric. Log-likelihood (only when objective = "MLE").
- n\_obs** Integer. Number of observations (for AIC/BIC).

### See Also

[fitVariogramST](#), [selectModelST](#), [test\\_separability](#)

### Examples

```
library(spacetime)
library(sp)
library(sftime)
data(air)
stations <- st_as_sf(stations)
stations <- st_transform(stations, 'EPSG:3857')
airdf <- data.frame(PM10 = as.vector(air))
```

```

stations_full <- do.call(c, rep(stations, length(dates)))
dates_full <- rep(dates, each = nrow(stations))
rural <- cbind(airdf, time = dates_full, stations_full)
rural <- st_as_sf(rural, sf_column_name = 'geometry')
rr <- rural[match(rural$time, dates[3001:3060]), nomatch = FALSE] > 0, ]
rr <- as(as(as(rr, "STIDF"), "STFDF"), "STSDF")
rrstv <-
  autofitVariogramST(
    stf = rr,
    formula = PM10 ~ 1,
    surface = TRUE,
    cutoff = 2e6,
    width = 2e5,
    tlags = 0:6)
rrstv

```

---

autoKrigeST

*Automatic Spatio-Temporal Kriging*


---

## Description

Convenience wrapper that fits the variogram and predicts in one call. Internally calls [fitVariogramST](#) then [predictKrigeST](#).

## Usage

```

autoKrigeST(
  formula,
  input_data,
  new_data,
  type_stv = "sumMetric",
  block = 0,
  model = c("Sph", "Exp", "Gau", "Ste"),
  kappa = c(0.05, seq(0.2, 2, 0.1), 5, 10),
  fix.values = c(NA, NA, NA),
  newdata_mode = "rect",
  newdata_npoints = 3000,
  GLS.model = NA,
  tlags = 0:6,
  cutoff = 20000,
  width = 500,
  forward = 6,
  predict_chunk = NULL,
  nmax = Inf,
  aniso_method = "vgm",
  type_joint = "Exp",
  prodsum_k = 0.25,
  surface = FALSE,

```

```

start_vals = c(NA, NA, NA),
miscFitOptions = list(),
measurement_error = c(0, 0, 0),
cores = 1L,
verbose = TRUE,
optimizer = "lbfgsb",
objective = "WLS",
n_restart = 1L,
optimizer_control = list()
)

```

### Arguments

formula	A formula (e.g. PM10 ~ 1).
input_data	Training data (STFDF, STSDF, STIDF, or sftime).
new_data	Prediction grid. If missing, generated automatically via <a href="#">create_new_data.ST</a> .
type_stv	Character. ST variogram model type. Passed as <code>typestv</code> to <a href="#">autofitVariogramST</a> .
block	Numeric. Block size for block Kriging.
model	Character vector. Candidate marginal variogram model families.
kappa	Numeric vector. Kappa values for Matern-family models.
fix.values	Numeric vector (3). Fixed initial values for nugget, range, sill.
newdata_mode	Character. "rect" or "chull".
newdata_npoints	Integer. Number of prediction grid points.
GLS.model	Variogram model for GLS sample variogram (rarely needed).
tlags	Integer vector. Temporal lags.
cutoff	Numeric. Maximum spatial lag.
width	Numeric. Spatial lag bin width.
forward	Integer. Number of future time steps to predict.
predict_chunk	Integer or NULL. Chunk size for large prediction grids.
nmax	Numeric. Maximum number of ST neighbours.
aniso_method	Character. Anisotropy estimation method.
type_joint	Character. Joint variogram component model family.
prodsum_k	Numeric. k parameter for productSum models.
surface	Logical. Return variogram surface?
start_vals	Numeric vector (3). Not used in v2.0 (kept for API compat).
miscFitOptions	List. Not used in v2.0 (kept for API compat).
measurement_error	Numeric vector (3). Measurement error components.
cores	Integer. Cores for variogramST computation.
verbose	Logical. Print progress messages.

optimizer Character. One of "lbfgsb" (default), "grid", "sa" (simulated annealing), or "ga" (genetic algorithm).

objective Character. "WLS" or "MLE".

n\_restart Integer. Number of optimisation restarts.

optimizer\_control List. Extra control arguments for the optimiser.

### Value

An autoKrigeST object.

### Examples

```
library(spacetime)
library(gstat)
data(air)
deair <- STFDF(stations, dates, data.frame(PM10 = as.vector(air)))
deair_rs <- deair[, 3751:3800]
## Not run:
## Not run:
akst <- autoKrigeST(formula = PM10 ~ 1, input_data = deair_rs,
                    cutoff = 300000, width = 30000, tlags = 0:7, cores = 4)

## End(Not run)
```

---

autoKrigeST.cv

*Cross-validation of spatiotemporal Kriging*

---

### Description

Cross-validation of spatiotemporal Kriging

### Usage

```
autoKrigeST.cv(
  data,
  fold_dim = c("spatial", "temporal", "random", "spacetime"),
  nfold = 10L,
  formula,
  type_stv = "sumMetric",
  block = 0,
  model = c("Sph", "Exp", "Gau", "Ste"),
  kappa = c(0.05, seq(0.2, 2, 0.1), 5, 10),
  fix.values = c(NA, NA, NA),
  tlags = 0:6,
  cutoff = 20000,
  width = 500,
```

```

nmax = Inf,
aniso_method = "vgm",
type_joint = "Exp",
prodsum_k = 0.25,
surface = FALSE,
start_vals = c(NA, NA, NA),
miscFitOptions = list(),
measurement_error = c(0, 0, 0),
cores = 1,
seed = 130425L,
variogram_from_full = FALSE,
optimizer = "lbfgsb",
objective = "WLS",
n_restart = 1L,
optimizer_control = list()
)

```

### Arguments

data	a 'STFDF'-class object
fold_dim	character. the dimension at which you want to cross-validate (spatial, temporal, and random)
nfold	integer. the number of folds. 10 as the default
formula	formula. e.g., $y \sim 1$
type_stv	character. One of 'sumMetric', 'metric', 'productSum', and 'separable'
block	numeric. passed to conduct block spatiotemporal Kriging.
model	character vector. Default is c("Sph", "Exp", "Gau", "Ste"), but users can specify the list of theoretical variograms by referring <code>gstat::vgm</code> .
kappa	numeric vector. Kappa values tested for Matern-family variogram models.
fix.values	numeric vector. Initial values in order of nugget, range, and sill, respectively.
tlags	integer vector (increasing, preferably to be consecutive). temporal lags.
cutoff	numeric. The maximum distance at which the sample variogram will be computed.
width	numeric. The interval at which the variogram cloud will be summarized.
nmax	integer or positive infinite. The maximum number of spatiotemporal neighbors to conduct the local spatiotemporal Kriging.
aniso_method	character. One of 'vgm', 'linear', 'range', and 'metric'. Please refer to <code>?gstat::estiStAni</code> .
type_joint	character. The model form of joint spatiotemporal variogram.
prodsum_k	numeric. The parameter for the case when 'productSum' is chosen for <code>type_stv</code> .
surface	logical. If TRUE, also return variogram surface in fitting path.
start_vals	numeric vector (3). The initial values to optimize the spatiotemporal variogram model.
miscFitOptions	list. See <code>?automap::autofitVariogram</code> .

measurement\_error      numeric vector of length 3: spatial, temporal, and joint measurement error terms.  
 cores                    integer. The number of threads that will be used to compute the sample spatiotemporal variogram.  
 seed                     integer. Random seed for fold generation.  
 variogram\_from\_full      logical. If TRUE, fit one ST variogram on full data and reuse across folds.  
 optimizer                character. Optimization method passed to ST variogram fitting.  
 objective                character. Objective for ST variogram fitting ('WLS' or 'MLE').  
 n\_restart                integer. Number of restarts for optimizer = 'lbfgsb'.  
 optimizer\_control        list. Extra control options forwarded to the selected optimizer.

### Value

The cross-validated spatiotemporal Kriging results.

### Examples

```

library(sp)
library(gstat)
library(spacetime)
library(stars)
library(dplyr)
data(air)
deair <- STFDF(stations, dates, data.frame(PM10 = as.vector(air)))
deair_sf <- st_as_stars(deair, crs = "+proj=longlat +ellps=sphere")
deair_sf <- st_transform(deair_sf, 3857)
deair_r <- as(deair_sf, "STFDF")
deair_r@sp@proj4string <- CRS("EPSG:3857")
deair_rs <- deair_r[, 3751:3800]
## autoKrigeST.cv test
## Not run:
akst_cv_t <- autoKrigeST.cv(
  formula = PM10 ~ 1, data = deair_rs, nfold = 3, fold_dim = "temporal",
  cutoff = 300000, width = 30000, tlags = 0:7, cores = 8
)
akst_cv_s <- autoKrigeST.cv(
  formula = PM10 ~ 1, data = deair_rs, nfold = 3, fold_dim = "spatial",
  cutoff = 300000, width = 30000, tlags = 0:7, cores = 8
)
# akst_cv_r = autoKrigeST.cv(formula = PM10~1, data = deair_rs, nfold = 3, fold_dim = 'random',
#                            cutoff = 300000, width = 30000, tlags = 0:7, cores = 8)
akst_cv_spt <- autoKrigeST.cv(
  formula = PM10 ~ 1, data = deair_rs, nfold = 4, fold_dim = "spacetime",
  cutoff = 300000, width = 30000, tlags = 0:7, cores = 8
)

## End(Not run)

```

---

create_new_data	<i>Create new spatial data for interpolation</i>
-----------------	--

---

**Description**

Create new spatial data for interpolation

**Usage**

```
create_new_data(obj, gen_mode = "chull", npoints = 10000, return_class = "sf")
```

**Arguments**

obj	A Spatial*DataFrame.
gen_mode	character. One of 'rect' (rectangular) and 'chull' (convex hull).
npoints	integer. the number of points that will be generated
return_class	character(1). One of 'sf' and 'sp'

**Value**

A sf (return\_class == 'sf') or SpatialPointsDataFrame (return\_class == 'sp').

---

create_new_data.ST	<i>Generate a new spatiotemporal points for the spatiotemporal prediction and interpolation</i>
--------------------	---

---

**Description**

Generate a new spatiotemporal points for the spatiotemporal prediction and interpolation

**Usage**

```
create_new_data.ST(obj, form, gen_mode = "chull", npoints = 10000, forward = 6)
```

**Arguments**

obj	a sftime object.
form	formula.
gen_mode	character. The type of shape by the surface is generated. One of 'rect' (rectangular) and 'chull' (convex hull).
npoints	integer. the number of points that will be generated
forward	integer. the time length of the data will generate ahead of the last time point of the input data. If NULL is passed, the spatiotemporal interpolation mode in obj will be conducted.

**Value**

A sftime object.

---

create\_new\_data.ST.legacy

*Generate a new spatiotemporal points for the spatiotemporal prediction and interpolation (legacy sp)*

---

**Description**

Generate a new spatiotemporal points for the spatiotemporal prediction and interpolation (legacy sp)

**Usage**

```
create_new_data.ST.legacy(
  obj,
  form,
  gen_mode = "chull",
  npoints = 10000,
  forward = 6
)
```

**Arguments**

obj	a ST*DF object.
form	formula.
gen_mode	character. One of 'rect' (rectangular) and 'chull' (convex hull).
npoints	integer. the number of points that will be generated
forward	integer. the time length of the data will generate ahead of the last time point of the input data. If NULL is passed, the spatiotemporal interpolation mode in obj will be conducted.

**Value**

A STFDF object.

---

`cubble_to_sftime`      *Convert a cubble object to an sftime object*

---

### Description

Handles both nested and temporal faces of a **cubble** object. The resulting `sftime` has one row per (location × time) observation with the spatial geometry attached to every row.

### Usage

```
cubble_to_sftime(x, time_col = NULL, key_col = NULL)
```

### Arguments

<code>x</code>	A <code>cubble_df</code> object (from the <b>cubble</b> package).
<code>time_col</code>	Character. Name of the time column in the temporal face. If <code>NULL</code> (default), the function tries to detect it automatically by looking for <code>POSIXct/Date</code> columns.
<code>key_col</code>	Character. Name of the site identifier column shared by the spatial and temporal faces. Detected automatically from <code>cubble::key_vars()</code> when <code>NULL</code> .

### Value

An `sftime` object with a geometry column (`sfc_POINT`).

---

`detect_temporal_unit`      *Autodetect the temporal unit*

---

### Description

Autodetect the temporal unit

### Usage

```
detect_temporal_unit(temporal)
```

### Arguments

<code>temporal</code>	<code>xts</code> object.
-----------------------	--------------------------

### Value

A character that indicates the temporal unit of the input `xts` object.

---

`detect_temporal_unit.generic`

*Autodetect the temporal unit in a lubridate/POSIXct object*

---

**Description**

Autodetect the temporal unit in a lubridate/POSIXct object

**Usage**

`detect_temporal_unit.generic(temporal)`

**Arguments**

`temporal` a lubridate/POSIXct object.

**Value**

A character that indicates the temporal unit of the input xts object.

---

`detect_temporal_unit.xts`

*Autodetect the temporal unit in a xts object*

---

**Description**

Autodetect the temporal unit in a xts object

**Usage**

`detect_temporal_unit.xts(temporal)`

**Arguments**

`temporal` a xts object.

**Value**

A character that indicates the temporal unit of the input xts object.

---

 estimate\_initial\_params

*Estimate Initial ST Variogram Parameters from Empirical Data*


---

## Description

Derives nugget, partial sill, spatial range, and temporal range directly from the empirical spatio-temporal variogram instead of relying on fixed arithmetic heuristics. The approach is:

## Usage

```
estimate_initial_params(
  stva_emp,
  nugget_quantile = 0.25,
  sill_quantile = 0.95,
  practical_range_target = 0.95
)
```

## Arguments

stva_emp	An empirical StVariogram (data.frame with columns spacelag, timelag, gamma, np).
nugget_quantile	Numeric in (0, 1). Quantile of near-zero-lag gamma used as the nugget estimate. Default 0.25 (lower quartile of the first decile of spatial bins).
sill_quantile	Numeric in (0, 1). Quantile of the spatial-marginal gamma values used as the plateau estimate. Default 0.95.
practical_range_target	Numeric in (0, 1). Fraction of the sill at which the practical range is read off. Default 0.95.

## Details

1. **Nugget** — median  $\gamma$  over the first decile of spatial lags (extrapolation toward zero-lag).
2. **Sill** — 95th percentile of  $\gamma$  values over all spatial lags at the minimum time lag (spatial marginal plateau).
3. **Spatial practical range** — smallest spatial lag at which the spatial marginal exceeds 95% of the estimated sill; falls back to 50% of the maximum spatial lag when the variogram never reaches the sill within the sampling window.
4. **Temporal practical range** — same rule applied to the temporal marginal at the minimum spatial lag.

**Value**

A named list:

**nugget** Estimated nugget ( $\geq 0$ ).

**psill** Estimated partial sill (sill - nugget,  $\geq 0$ ).

**sill** Estimated total sill.

**sp\_range** Estimated spatial practical range.

**ts\_range** Estimated temporal practical range.

**max\_gamma** Maximum observed gamma.

**max\_splag** Maximum spatial lag in the empirical variogram.

**max\_tlag** Maximum temporal lag (numeric).

---

fitVariogramST	<i>Fit a Spatio-Temporal Variogram</i>
----------------	--

---

**Description**

A named wrapper around [autofitVariogramST](#) that makes the fit/predict separation explicit. Returns a STVariogramFit object which can be passed directly to [predictKrigeST](#).

**Usage**

```
fitVariogramST(formula, data, ...)
```

**Arguments**

formula	A formula (e.g. PM10 ~ 1).
data	A spatio-temporal data object (STFDF, STSDF, STIDF, or sftime).
...	Arguments forwarded to <a href="#">autofitVariogramST</a> .

**Value**

A STVariogramFit object.

**See Also**

[predictKrigeST](#), [autoKrigeST](#)

---

ic_stv	<i>Compute AIC and BIC for a fitted STVariogramFit (MLE-based)</i>
--------	--

---

**Description**

Compute AIC and BIC for a fitted STVariogramFit (MLE-based)

**Usage**

```
ic_stv(fit_obj, n_obs)
```

**Arguments**

fit_obj	A STVariogramFit object with an objective = "MLE" fit (i.e., fit_obj\$loglik must not be NULL).
n_obs	Integer. Number of observations used for fitting.

**Value**

A named list: AIC, BIC, k (number of free parameters), loglik.

---

marginal.variogramST	<i>Compute the marginal spatial or temporal sample variogram</i>
----------------------	--

---

**Description**

Compute the marginal spatial or temporal sample variogram

**Usage**

```
marginal.variogramST(stv, bound, spatial = TRUE)
```

**Arguments**

stv	A StVariogram and data.frame object.
bound	numeric. The maximum distance that will be used to compute a spatial variogram.
spatial	boolean. if TRUE, the spatial marginal variogram will be obtained, temporal otherwise.

**Value**

A gstatVariogram object.

---

plot.autofitVariogram *Plot the automatically fitted variogram*

---

### Description

Plot the automatically fitted variogram

### Usage

```
## S3 method for class 'autofitVariogram'
plot(
  x,
  plotit = TRUE,
  title = "Experimental variogram and fitted variogram model",
  ...
)
```

### Arguments

x	A result object of autofitVariogram.
plotit	boolean. Print graph or not.
title	character. the title of the plot.
...	passed to xyplot

### Value

A lattice::xyplot object.

---

plot\_aniso\_sensitivity *Sensitivity Plot of the Spatio-Temporal Anisotropy Ratio*

---

### Description

Evaluates `gstat::estiStAni` at a sequence of spatial intervals and plots how the estimated anisotropy ratio varies. Useful for diagnosing whether the single-interval estimate used in `autofitVariogramST` is stable.

### Usage

```
plot_aniso_sensitivity(
  stva_emp,
  spatial_vgm,
  temporal_vgm,
  n_intervals = 20L,
  plot = TRUE
)
```

**Arguments**

stva_emp	Empirical ST variogram from setSTI.
spatial_vgm	Fitted spatial marginal variogram model.
temporal_vgm	Fitted temporal marginal variogram model.
n_intervals	Integer. Number of evaluation intervals.
plot	Logical. Whether to produce a base-R plot.

**Value**

Invisibly, a data.frame with columns interval and stAni.

---

predictKrigeST	<i>Predict Using a Fitted Spatio-Temporal Kriging Model</i>
----------------	---

---

**Description**

Takes a STVariogramFit object (from [fitVariogramST](#) or [autofitVariogramST](#)) and performs spatiotemporal Kriging at the locations in newdata.

**Usage**

```
predictKrigeST(
  fit,
  data,
  newdata,
  formula,
  nmax = Inf,
  predict_chunk = NULL,
  ...
)
```

**Arguments**

fit	A STVariogramFit object.
data	The original data used to fit the variogram (STFDF, STSDF, STIDF, or sftime).
newdata	Prediction grid (STFDF or sftime).
formula	Formula used during fitting.
nmax	Passed to <code>gstat::krigeST</code> .
predict_chunk	Optional integer; splits newdata into chunks for large grids to avoid memory issues.
...	Additional arguments forwarded to <code>gstat::krigeST</code> .

**Value**

An autoKrigeST object (list) with elements krige\_output (STFDF) and var\_model.

**See Also**

[fitVariogramST](#), [autoKrigeST](#)

---

 selectModelST

*Automated Spatio-Temporal Covariance Model Selection*


---

**Description**

Fits multiple ST covariance model types and ranks them by a user-chosen criterion.

**Usage**

```
selectModelST(
  stf,
  formula,
  candidates = c("separable", "productSum", "sumMetric", "simpleSumMetric", "metric"),
  criterion = c("WLS", "AIC", "BIC"),
  optimizer = "lbfgsb",
  cores = 1L,
  ...
)
```

**Arguments**

stf	A spatio-temporal data object (STFDF, STSDF, STIDF, or sftime).
formula	A formula (e.g., $PM_{10} \sim 1$ ).
candidates	Character vector of ST model types to try. Defaults to all six supported types.
criterion	One of "AIC", "BIC" (require objective = "MLE"), "CV_RMSE" (not yet implemented in v2.0; use "WLS" as a fast proxy), or "WLS".
optimizer	Passed to autofitVariogramST.
cores	Passed to autofitVariogramST.
...	Additional arguments forwarded to autofitVariogramST.

**Value**

An STModelSelection object (list) with elements best\_model, comparison (data.frame), and all\_fits.

---

 setSTI
 

---

*A convenience function for the sample spatiotemporal variogram*


---

**Description**

A convenience function for the sample spatiotemporal variogram

**Usage**

```
setSTI(
  stf,
  formula,
  tlags = 0:6,
  cutoff = 30000,
  width = 1000,
  assumeRegular = FALSE,
  pseudo = TRUE,
  na.omit = TRUE,
  wireframe = FALSE,
  plot3d = FALSE,
  cores = 1
)
```

**Arguments**

stf	A ST*DF object.
formula	formula (inherits the same parameter in variogramST)
tlags	temporal lags to compute semivariance (inherits the same parameter in variogramST)
cutoff	the maximum bound of the set of spatial lags (inherits the same parameter in variogramST)
width	integer (1). spatial lag (inherits the same parameter in variogramST)
assumeRegular	Boolean. Assuming regular grid?
pseudo	Boolean. See ?gstat::variogramST
na.omit	Boolean. Omit NA values.
wireframe	Boolean. Whether you plot a StVariogram in wireframe or not. If not, the return will be in class of data.frame, not a list
plot3d	Boolean. Whether you make a three-dimensional graph with rgl package
cores	Integer. Number of threads passed to gstat::variogramST.

**Value**

Depends on the arguments wireframe (if TRUE, list of length 2) and plot3d (if TRUE, list of length 3), a StVariogram object otherwise.

---

st_param_bounds	<i>Compute parameter bounds for vgmST model optimisation</i>
-----------------	--

---

**Description**

Compute parameter bounds for vgmST model optimisation

**Usage**

```
st_param_bounds(
  model_template,
  stva_emp,
  sill_scale = 2,
  range_scale = 3,
  ani_scale = 20
)
```

**Arguments**

model_template	A vgmST object (initial guess).
stva_emp	Empirical ST variogram (StVariogram/data.frame) from setSTI or gstat::variogramST.
sill_scale	Numeric (2). Upper bound multiplier applied to $\max(\text{stva\_emp}\$\gamma)$ for sill/psill/nugget parameters.
range_scale	Numeric (3). Upper bound multiplier applied to the maximum spatial lag for range parameters.
ani_scale	Numeric (20). Controls the breadth of the stAni search interval relative to the data extent.

**Value**

A named list with elements lower and upper (both named numeric vectors matching `gstat::extractPar(model_template)`

---

test_separability	<i>Likelihood Ratio Test for Spatiotemporal Separability</i>
-------------------	--

---

**Description**

Tests whether a separable covariance structure is adequate versus the more general sumMetric model using a likelihood ratio test (LRT). Both models are fitted with `objective = "MLE"`.

**Usage**

```
test_separability(stf, formula, ...)
```

**Arguments**

<code>stf</code>	Spatio-temporal data (STFDF, STSDF, STIDF, or sftime).
<code>formula</code>	Formula, e.g. $PM_{10} \sim 1$ .
<code>...</code>	Additional arguments forwarded to <code>autofitVariogramST</code> (e.g. <code>tlags</code> , <code>cutoff</code> , <code>width</code> , <code>cores</code> ).

**Value**

A list with elements:

**statistic** LRT chi-squared statistic.

**df** Degrees of freedom (difference in number of parameters).

**p\_value** p-value from chi-squared distribution.

**separable\_fit** Fitted `STVariogramFit` for the separable model.

**summetric\_fit** Fitted `STVariogramFit` for the sumMetric model.

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