Package ‘spm2’

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Title Spatial Predictive Modeling
Version 1.1.2
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Description An updated and extended version of ‘spm’ package, by introducing some further novel functions for modern statistical methods (i.e., generalised linear models, glmnet, generalised least squares), thin plate splines, support vector machine, kriging methods (i.e., simple kriging, universal kriging, block kriging, kriging with an external drift), and novel hybrid methods (228 hybrids plus numerous variants) of modern statistical methods or machine learning methods with mathematical and/or univariate geostatistical methods for spatial predictive modelling. For each method, two functions are provided, with one function for assessing the predictive errors and accuracy of the method based on cross-validation, and the other for generating spatial predictions. It also contains a couple of functions for data preparation and predictive accuracy assessment.

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Author Jin Li [aut, cre]
Maintainer Jin Li <jinli68@gmail.com>
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R topics documented:

bees ................................................................. 2
ccr ............................................................... 5
bees

A dataset of bees count data and relevant information in oilseed Brassica fields in an Australian temperate landscape.

Description

This dataset contains 212 samples of 61 variables including three bee species, inflorescence, temperature, wind speed and various derived landscape variables.
Usage

```r
data("bees")
```

Format

A data frame with 212 observations on the following 61 variables.

pair a factor with levels I O
inf a numeric vector
rankinf a numeric vector
dupl a numeric vector
temp a numeric vector
windspeed a numeric vector
winddir a factor with levels N NE NNE NNW NW
cloudc a numeric vector
disttoedgescalc a numeric vector
disttoedgedmeasured a numeric vector
w100 a numeric vector
w200 a numeric vector
w300 a numeric vector
w400 a numeric vector
w500 a numeric vector
w600 a numeric vector
w700 a numeric vector
w800 a numeric vector
w900 a numeric vector
w1000 a numeric vector
w1500 a numeric vector
w2000 a numeric vector
c100 a numeric vector
c200 a numeric vector
c300 a numeric vector
c400 a numeric vector
c500 a numeric vector
c1000 a numeric vector
c1500 a numeric vector
area a numeric vector
perimeter a numeric vector
gyration a numeric vector
paratio a numeric vector
shape a numeric vector
fractaldimension a numeric vector
circumscircle a numeric vector
contiguity a numeric vector
Details

For details, please see the source. This dataset was published as an appendix of the paper listed in the source. Where the long and lat were reprojected to easting and northing.

Source


References


description

This function is to calculates correct classification rate (ccr) for categorical data with the observed (obs) data specified as factor. It based on the differences between the predicted values for and the observed values of validation samples for cross-validation. For 0 and 1 data, the observed values need to be specified as factor in order to use this accuracy measure. It is modified from the function 'pred.acc' in 'spm' package.

Usage

ccr(obs, pred)
Arguments

obs     a vector of observation values of validation samples.
pred    a vector of prediction values of predictive models for validation samples.

Value

A list with the following component: ccr (correct classification rate) for categorical data.

Author(s)

Jin Li

References


Examples

```r
set.seed(1234)
x <- as.factor(sample(letters[1:2], 30, TRUE))
y <- sample(x, 30)
ccr(x, y)
```

Description

This is an updated and extended version of ‘spm’ package. The change in package name from ‘spm’ to ‘spm2’ is due to the change in Author’s support from Geoscience Australia to Data2Action Australia.

```r
## R CMD check results 0 errors | 0 warnings | 0 notes
```

Author(s)

Jin Li
datasplit  

**Description**

This function is a data splitting function for k-fold cross-validation and uses a stratified random sampling technique. It resamples the training data based on sample quantiles.

**Usage**

```r
datasplit(trainy, k.fold = 10)
```

**Arguments**

- `trainy`: a vector of response, must have a length equal to sample size.
- `k.fold`: integer; number of folds in the cross-validation. if > 1, then apply k-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.

**Value**

A list of samples each with an index of k-fold number.

**Note**

This function is largely based on rfcv in randomForest.

**Author(s)**

Jin Li

**References**


**Examples**

```r
library(spm)
data(petrel)
idx1 <- datasplit(petrel[, 3], k.fold = 10)
table(idx1)
```
decimaldigit  

*Digit number after decimal point for a numeric variable*

**Description**

This function is to derive the digit number after decimal point for a numeric variable (e.g., lat and long).

**Usage**

```r
decimaldigit(x, dechar = ".", nint = NA, ndec = NA, pad.left = TRUE)
```

**Arguments**

- `x`: one or more decimal numbers.
- `dechar`: The character used to separate the decimal part of a number.
- `nint`: The number of characters to which the integer part of the numbers should be padded.
- `ndec`: The number of characters to which the decimal part of the numbers should be padded.
- `pad.left`: Whether the left (integer) side of the numbers should be padded as well as the right.

**Value**

A list of integer number to show digit number after decimal point of `x`.

**Note**

This function is modified from decimal.align in ’prettyR’ package.

**Author(s)**

Jin Li

**References**


**Examples**

```r
x<-c(0.1, 2.2, 3.03, 44.444, 555.0005, 6666.66666)
decimaldigit(x)
```
gbmkrigeidwcv

Cross validation, n-fold and leave-one-out for the hybrid methods of generalized boosted regression modeling ('gbm'), 'kriging' and inverse distance weighted ('IDW').

Description

This function is a cross validation function for 38 hybrid methods of 'gbm', 'kriging' and 'IDW', including the average of 'gbmkrige' and 'gbmidw' ('gbmkrigeidw') and the average of 'gbm', 'gbmkrige' and 'gbmidw' ('gbmgbmkrigeidw'), where 'kriging' methods include ordinary kriging ('OK'), simple kriging ('SK'), block 'OK' ('BOK') and block 'SK' ('BSK') and 'IDW' also covers 'NN' and 'KNN'. The data splitting is based on a stratified random sampling method (see the 'datasplit' function for details).

Usage

gbmkrigeidwcv(
  longlat,
  trainx,
  trainy,
  var.monotone = rep(0, ncol(trainx)),
  family = "gaussian",
  n.trees = 3000,
  learning.rate = 0.001,
  interaction.depth = 2,
  bag.fraction = 0.5,
  train.fraction = 1,
  n.minobsinnode = 10,
  transformation = "none",
  weights = rep(1, nrow(trainx)),
  keep.data = FALSE,
  verbose = TRUE,
  delta = 1,
  formula = res1 ~ 1,
  vgm.args = "Sph",
  anis = c(0, 1),
  alpha = 0,
  block = 0,
  beta,
  nmaxkrige = 12,
  idp = 2,
  nmaxidw = 12,
  hybrid.parameter = 2,
  lambda = 1,
  validation = "CV",
  cv.fold = 10,
  predacc = "VEcv",
)
Arguments

longlat  a dataframe contains longitude and latitude of point samples.

trainx  a dataframe or matrix contains columns of predictive variables.

trainy  a vector of the response variable.

var.monotone  an optional vector, the same length as the number of predictors, indicating which variables have a monotone increasing (+1), decreasing (-1), or arbitrary (0) relationship with the outcome. By default, a vector of 0 is used.

family  either a character string specifying the name of the distribution to use or a list with a component name specifying the distribution and any additional parameters needed. See gbm for details. By default, "gaussian" is used.

n.trees  the total number of trees to fit. This is equivalent to the number of iterations and the number of basis functions in the additive expansion. By default, 3000 is used.

learning.rate  a shrinkage parameter applied to each tree in the expansion. Also known as step-size reduction.

interaction.depth  the maximum depth of variable interactions. 1 implies an additive model, 2 implies a model with up to 2-way interactions, etc. By default, 2 is used.

bag.fraction  the fraction of the training set observations randomly selected to propose the next tree in the expansion. By default, 0.5 is used.

train.fraction  The first train.fraction * nrow(data) observations are used to fit the gbm and the remainder are used for computing out-of-sample estimates of the loss function.

n.minobsinnode  minimum number of observations in the trees terminal nodes. Note that this is the actual number of observations not the total weight. By default, 10 is used.

transformation  transform the residuals of 'gbm' to normalize the data for 'krige'; can be "sqrt" for square root, "arcsine" for arcsine, "log" or "none" for non transformation. By default, "none" is used.

weights  an optional vector of weights to be used in the fitting process. Must be positive but do not need to be normalized. If keep.data = FALSE in the initial call to gbm then it is the user’s responsibility to resupply the weights to gbm.more. By default, a vector of 1 is used.

keep.data  a logical variable indicating whether to keep the data and an index of the data stored with the object. Keeping the data and index makes subsequent calls to gbm.more faster at the cost of storing an extra copy of the dataset. By default, 'FALSE' is used.

verbose  If TRUE, gbm will print out progress and performance indicators. By default, 'TRUE' is used.

delta  numeric; to avoid log(0) in the log transformation. The default is 1.
formula  formula defining the response vector and (possible) regressor. an object (i.e., 'variogram.formula') for 'variogram' or a formula for 'krige'. see 'variogram' and 'krige' in 'gstat' for details. The default is 'formula = res1 ~ 1'.

vgm.args arguments for 'vgm', e.g. variogram model of response variable and anisotropy parameters. see 'vgm' in 'gstat' for details. By default, "Sph" is used.

anis  anisotropy parameters: see notes 'vgm' in 'gstat' for details.

alpha  direction in plane (x,y). see variogram in 'gstat' for details.

block  block size. see 'krige' in 'gstat' for details.

beta  for simple kriging. see 'krige' in 'gstat' for details.

nmaxkrige  for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

idp  a numeric number specifying the inverse distance weighting power.

nmaxidw  for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

hybrid.parameter  the default is 2 that is for 'gbmkrigeidw'; for 'gbmgbmkrigegbmidw', it needs to be 3.

lambda,  ranging from 0 to 2; the default is 1 for 'gbmkrigeidw' and 'gbmgbmkrigegbmidw'; and if it is < 1, more weight is placed on 'krige', otherwise more weight is placed on 'idw'; and if it is 0, 'idw' is not considered and the resultant methods is 'gbmkrige' when the default 'hybrid.parameter' is used; and if it is 2, then the resultant method is 'gbmidw' when the default 'hybrid.parameter' is used.

validation  validation methods, include 'LOO': leave-one-out, and 'CV': cross-validation.

cv.fold  integer; number of folds in the cross-validation. if > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.

predacc  can be either "VEcv" for vecv or "ALL" for all measures in function pred.acc.

n.cores  The number of CPU cores to use. See gbm for details. By default, 8 is used.

... other arguments passed on to 'randomForest', 'krige' and 'gstat'.

Value

A list with the following components: me, rme, mae, rmae, mse, rmse, vecv and e1; or vecv only

Note

This function is largely based on 'gbmcv' in 'spm', and 'krigecv' in 'spm2'.

Author(s)

Jin Li
References


Examples

```r
library(spm)
# gbmgbmokgbmidw
data(sponge)
longlat <- sponge[, 1:2]
set.seed(1234)
gbmgbmkrigeidwcv1 <- gbmkrigeidwcv(longlat = longlat,
trainx = sponge[, -3], trainy = sponge[, 3], family = "poisson", interaction.depth = 3,
transformation = "none", formula = res1 ~ 1, vgm.args = "Sph",
nmaxkrige = 12, idp = 2, nmaxidw = 12, hybrid.parameter = 3, validation = "CV",
predacc = "ALL", n.cores = 8)

# gbmokgbmidw for count data
data(sponge)
longlat <- sponge2[, 1:2]
y = sponge[, 3]
trainx = sponge[, -3]
set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
  gbmkrigeidwcv1 <- gbmkrigeidwcv(longlat = longlat,
  trainx = trainx, trainy = y, family = "poisson", interaction.depth = 3,
  transformation = "none", formula = res1 ~ 1, vgm.args = "Sph",
  nmaxkrige = 12, idp = 2, nmaxidw = 12, hybrid.parameter = 2, validation = "CV",
  predacc = "VEcv", n.cores = 8)
  VEcv [i] <- gbmkrigeidwcv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for gbmokgbmidw", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) - c(1:n), col = 2)
abline(h = mean(VEcv), col = 'blue', lwd = 2)
```
Generate spatial predictions using the hybrid methods of generalized boosted regression modeling ('gbm'), 'kriging' and inverse distance weighted ('IDW').

Description

This function is for generating spatial predictions using the hybrid methods of 'gbm', 'kriging' and 'IDW', including all methods implemented in 'gbmkrigeidwcv'.

Usage

```r
gbmkrigeidwpred(
  longlat,
  trainx,
  predx,
  trainy,
  longlatpredx,
  var.monotone = rep(0, ncol(trainx)),
  family = "gaussian",
  n.trees = 3000,
  learning.rate = 0.001,
  interaction.depth = 2,
  bag.fraction = 0.5,
  train.fraction = 1,
  n.minobsinnode = 10,
  transformation = "none",
  weights = rep(1, nrow(trainx)),
  keep.data = FALSE,
  verbose = TRUE,
  delta = 1,
  formula = res1 ~ 1,
  vgm.args = "Sph",
  anis = c(0, 1),
  alpha = 0,
  block = 0,
  beta,
  nmaxkrige = 12,
  idp = 2,
  nmaxidw = 12,
  hybrid.parameter = 2,
  lambda = 1,
  cv.fold = 10,
  n.cores = 8,
  ...
)
```
Arguments

longlat  a dataframe contains longitude and latitude of point samples.
trainx   a dataframe contains longitude (long), latitude (lat), predictive variables and the 
          response variable of point samples.
predx    a dataframe or matrix contains columns of predictive variables for the grids to 
          be predicted.
trainy   a vector of the response variable in the formula, that is, the left part of the for-
          mula.
longlatpredx  a dataframe contains longitude and latitude of point locations (i.e., the centers 
                of grids) to be predicted.
var.monotone  an optional vector, the same length as the number of predictors, indicating which 
              variables have a monotone increasing (+1), decreasing (-1), or arbitrary (0) re-
              lationship with the outcome. By default, a vector of 0 is used.
family     either a character string specifying the name of the distribution to use or a list 
            with a component name specifying the distribution and any additional parame-
            ters needed. See gbm for details. By default, "gaussian" is used.
n.trees    the total number of trees to fit. This is equivalent to the number of iterations 
            and the number of basis functions in the additive expansion. By default, 3000 is 
            used.
learning.rate  a shrinkage parameter applied to each tree in the expansion. Also known as 
               step-size reduction.
interaction.depth  the maximum depth of variable interactions. 1 implies an additive model, 2 
                   implies a model with up to 2-way interactions, etc. By default, 2 is used.
bag.fraction  the fraction of the training set observations randomly selected to propose the 
               next tree in the expansion. By default, 0.5 is used.
train.fraction The first 'train.fraction * nrows(data)' observations are used to fit the gbm and 
                 the remainder are used for computing out-of-sample estimates of the loss func-
                 tion.
n.minobsinnode minimum number of observations in the trees terminal nodes. Note that this is 
                  the actual number of observations not the total weight. By default, 10 is used.
transformation transform the residuals of 'gbm' to normalise the data; can be "sqrt" for square 
                   root, "arcsine" for arcsine, "log" or "none" for non transformation. By default, 
                   "none" is used.
weights     an optional vector of weights to be used in the fitting process. Must be positive 
            but do not need to be normalized. If keep.data = FALSE in the initial call to 
            gbm then it is the user’s responsibility to resupply the weights to gbm.more. By 
            default, a vector of 1 is used.
keep.data  a logical variable indicating whether to keep the data and an index of the data 
          stored with the object. Keeping the data and index makes subsequent calls to 
          gbm.more faster at the cost of storing an extra copy of the dataset. By default, 
          'FALSE' is used.
verbose    If TRUE, gbm will print out progress and performance indicators. By default, 
          'TRUE' is used.
delta numeric; to avoid log(0) in the log transformation. The default is 1.

formula formula defining the response vector and (possible) regressor. an object (i.e., `variogram.formula`) for `variogram` or a formula for `krige`. see `variogram` and 'krige' in `gstat` for details. The default is 'formula = res1 ~ 1'.

vgm.args arguments for 'vgm', e.g. variogram model of response variable and anisotropy parameters. see 'vgm' in 'gstat' for details. By default, "Sph" is used.

anis anisotropy parameters: see notes 'vgm' in 'gstat' for details.

alpha direction in plane (x,y). see variogram in 'gstat' for details.

block block size. see 'krige' in 'gstat' for details.

beta for simple kriging. see 'krige' in 'gstat' for details.

nmaxkrige for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

idp a numeric number specifying the inverse distance weighting power.

nmaxidw for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

hybrid.parameter the default is 2 that is for 'gbmkrigegbmidw'; for 'gbmgbmkrigegbmidw', it needs to be 3.

lambda, ranging from 0 to 2; the default is 1 for 'gbmkrigegbmidw' and 'gbmgbmkrigegbmidw'; and if it is < 1, more weight is placed on 'krige', otherwise more weight is placed on 'idw'; and if it is 0, 'idw' is not considered and the resultant methods is 'gbmkrige' when the default 'hybrid.parameter' is used; and if it is 2, then the resultant method is 'gbmidw' when the default 'hybrid.parameter' is used.

cv.fold integer; number of folds in the cross-validation. if > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.

n.cores The number of CPU cores to use. See gbm for details. By default, 6 is used.

... other arguments passed on to 'gbm', 'krige' and 'gstat'.

Value
A dataframe of longitude, latitude, and predictions.

Author(s)
Jin Li

References
Examples

```r
library(spm)
data(sponge)
data(sponge.grid)
longlat <- sponge[, 1:2]
set.seed(1234)

gbmkridgeidwpred1 <- gbmkrigeidwpred(longlat = longlat, trainx = sponge[, -3],
predx = sponge.grid, trainy = sponge[, 3], longlatpredx = sponge.grid[, c(1:2)],
family = "poisson", interaction.depth = 3, transformation = "none", formula = res1 ~ 1,
vgm.args = "Sph", nmaxkridge = 12, idp = 2, nmaxidw = 12, hybrid.parameter = 3,
n.cores = 8)

names(gbmkrigeidwpred1)

range(gbmkrigeidwpred1$predictions)
```

---

### glmcv

**Cross validation, n-fold and leave-one-out for generalised linear models (‘glm’)**

**Description**

This function is a cross validation function for ‘glm’ method in ‘stats’ package.

**Usage**

```r
glmcv(
  formula = NULL,
  trainxy,
  y,
  family = "gaussian",
  validation = "CV",
  cv.fold = 10,
)```
Arguments

formula  a formula defining the response variable and predictive variables.

trainxy  a dataframe contains predictive variables and the response variable of point samples. The location information, longitude (long), latitude (lat), need to be included in the 'trainx' for spatial predictive modeling.

y  a vector of the response variable in the formula, that is, the left part of the formula.

family  a description of the error distribution and link function to be used in the model. See '?glm' for details.

validation  validation methods, include 'LOO': leave-one-out, and 'CV': cross-validation.

cv.fold  integer; number of folds in the cross-validation. if > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.

predacc  can be either "VEcv" for vecv or "ALL" for all measures in function pred.acc.

Value

A list with the following components: me, rme, mae, rmae, mse, rmse, rrmse, vecv and e1; or vecv only

Note

This function is largely based on 'rfcv' in 'randomForest' and 'glm' in 'stats'.

Author(s)

Jin Li

References


Examples

library(spm)
data(petrel)
gravel <- petrel[, c(1, 2, 6:9, 5)]
model <- log(gravel + 1) ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)
set.seed(1234)
glmcv1 <- glmcv(formula = model, gravel, log(gravel[, 7] +1), validation = "CV",(predacc = "VEcv",
... )
glmidwcv # Cross validation, n-fold and leave-one-out for the hybrid method of generalised linear models ('glm') and inverse distance weighted ('IDW') ('glmidw')

describe

Description

This function is a cross validation function for the hybrid method of 'glm' and 'idw' using 'gstat' (glmidw) (see reference #1), where the data splitting is based on a stratified random sampling method (see the 'datasplit' function for details).

Usage

```
glimidwcv( formula = NULL, longlat, trainxy, y, family = "gaussian", idp = 2, nmaxidw = 12, validation = "CV", cv.fold = 10, ```
predacc = "VEcv",
...
)

Arguments

formula a formula defining the response variable and predictive variables for 'glm'.
longlat a dataframe contains longitude and latitude of point samples.
trainxy a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples.
y a vector of the response variable in the formula, that is, the left part of the formula.
family a description of the error distribution and link function to be used in the model. See '?glm' for details.
idp a numeric number specifying the inverse distance weighting power.
nmaxidw for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.
validation validation methods, include 'LOO': leave-one-out, and 'CV': cross-validation.
cv.fold integer; number of folds in the cross-validation. if > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.
predacc can be either "VEcv" for vecv or "ALL" for all measures in function pred.acc.
... other arguments passed on to 'glm' and 'gstat'.

Value

A list with the following components: me, rme, mae, rmae, mse, rmse, rrmse, vecv and e1; or vecv only.

Note

This function is largely based on 'rfcv' in 'randomForest', 'idwcv' in 'spm'and 'glm' in 'stats'.

Author(s)

Jin Li

References

Examples

```r
library(spm)

data(petrel)

gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
model <- log(gravel + 1) ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)
y <- log(gravel[, 7] + 1)

set.seed(1234)
glmidwcv1 <- glmidwcv(formula = model, longlat = longlat, trainxy = gravel,
y = y, idp = 2, nmaxidw = 12, validation = "CV", predacc = "ALL")
glmidwcv1 # Since the default 'family' is used, actually a 'lm' model is used.

data(spongelonglat)

longlat <- spongelonglat[, 7:8]
model <- sponge ~ long + I(long^2)
y = spongelonglat[, 1]

set.seed(1234)
glmidwcv1 <- glmidwcv(formula = model, longlat = longlat, trainxy = spongelonglat,
y = y, family = poisson, idp = 2, nmaxidw = 12, validation = "CV", predacc = "ALL")
glmidwcv1

# glmidw for count data

data(spongelonglat)

longlat <- spongelonglat[, 7:8]
model <- sponge ~ . # use all predictive variables in the dataset
y = spongelonglat[, 1]

set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
glmidwcv1 <- glmidwcv(formula = model, longlat = longlat, trainxy = spongelonglat,
y = y, family = poisson, idp = 2, nmaxidw = 12, validation = "CV", predacc = "VEcv")
VEcv [i] <- glmidwcv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for GLM", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) ~ c(1:n), col = 2)
abline(h = mean(VEcv), col = "blue", lwd = 2)

# glmidw for percentage data

library(MASS)

longlat <- petrel[, c(1, 2)]
model <- gravel / 100 ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)

set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
glmidwcv1 <- glmcv(formula = model, longlat = longlat, trainxy = gravel,

```
glmidwpred

generate spatial predictions using the hybrid method of generalized linear models ('glm') and inverse distance weighted ('IDW') ('glmidw')

Description

This function is for generating spatial predictions using the hybrid method of 'glm' and 'idw' ('glmidw') (see reference #1).

Usage

```r
glmidwpred(
  formula = NULL,
  longlat,
  trainxy,
  y,
  longlatpredx,
  predx,
  family = "gaussian",
  idp = 2,
  nmaxidw = 12,
  ...
)
```

Arguments

- `formula`: a formula defining the response variable and predictive variables for 'glm'.
- `longlat`: a dataframe contains longitude and latitude of point samples. The location information must be named as 'long' and 'lat'.
- `trainxy`: a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples. That is, the location information must be named as 'long' and 'lat'.
- `y`: a vector of the response variable in the formula, that is, the left part of the formula.
- `longlatpredx`: a dataframe contains longitude and latitude of point locations (i.e., the centers of grids) to be predicted.
predx a dataframe or matrix contains columns of predictive variables for the grids to be predicted.

family a description of the error distribution and link function to be used in the model. See '?glm' for details.

idp a numeric number specifying the inverse distance weighting power.

nmaxidw for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

... other arguments passed on to 'glm'.

Value

A dataframe of longitude, latitude, and predictions.

Author(s)

Jin Li

References


Examples

library(spm)
data(petrel)
data(petrel.grid)

gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
model <- log(gravel + 1) ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)
y <- log(gravel[, 7] +1)

glmwdpred1 <- glmwdpred(formula = model, longlat = longlat, trainxy = gravel, 
y = y, longlatpredx = petrel.grid[, c(1:2)], predx = petrel.grid, idp = 2, 
nmaxidw = 12)
# Since the default 'family' is used, actually a 'lm' model is used.

names(glmwdpred1)

# Back transform 'glmwdpred$predictions' to generate the final predictions
glmwdpred1$predictions.bt <- exp(glmwdpred1$predictions) - 1
range(glmwdpred1$predictions.bt)
glmkrigecv

Cross validation, n-fold and leave-one-out for the hybrid method of generalised linear models ('glm') and 'krige' ('glmkrige')

Description

This function is a cross validation function for the hybrid method of 'glm' and 'krige' (glmkrige), where 'krige' methods include ordinary kriging ('OK'), simple kriging ('SK'), block 'OK' ('BOK') and block 'SK' ('BSK') (see reference #1 for further info).

Usage

glmkrigecv(
  formula.glm = NULL,
  longlat,
  trainxy,
  y,
  family = "gaussian",
  transformation = "none",
  delta = 1,
  formula.krige = res1 ~ 1,
  vgm.args = c("Sph"),
  anis = c(0, 1),
  alpha = 0,
  block = 0,
  beta,
  nmaxkrige = 12,
  validation = "CV",
  cv.fold = 10,
  predacc = "VEcv",
  ...
)

Arguments

formula.glm a formula defining the response variable and predictive variables for 'glm'.
longlat a dataframe contains longitude and latitude of point samples.
trainxy a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples.
y a vector of the response variable in the formula, that is, the left part of the formula.
family a description of the error distribution and link function to be used in the model. See '?glm' for details.
transformation: transform the residuals of 'glm' to normalise the data; can be "sqrt" for square root, "arcsine" for arcsine, "log" or "none" for non transformation. By default, "none" is used.

delta: numeric; to avoid log(0) in the log transformation. The default is 1.

formula.krike: formula defining the response vector and (possible) regressor. an object (i.e., 'variogram.formula') for 'variogram' or a formula for 'krige'. see 'variogram' and 'krige' in 'gstat' for details.

vgm.args: arguments for 'vgm', e.g. variogram model of response variable and anisotropy parameters. see 'vgm' in 'gstat' for details. By default, "Sph" is used.

anis: anisotropy parameters: see notes 'vgm' in 'gstat' for details.

alpha: direction in plane (x,y). see variogram in 'gstat' for details.

block: block size. see 'krige' in 'gstat' for details.

beta: for simple kriging. see 'krige' in 'gstat' for details.

nmaxkrige: for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

validation: validation methods, include 'LOO': leave-one-out, and 'CV': cross-validation.

cv.fold: integer; number of folds in the cross-validation. if > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.

predacc: can be either "VEcv" for vecv or "ALL" for all measures in function pred.acc.

...: other arguments passed on to 'glm' and 'krige'.

Value

A list with the following components: me, rme, mae, rmae, mse, rmse, rrmse, vecv and e1; or vecv only

Note

This function is largely based on 'rfcv' in 'randomForest', 'krigecv' in 'spm2' and 'glm' in 'stats'.

Author(s)

Jin Li

References


Examples

```r
library(spm)
data(petrel)
gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
model <- log(gravel + 1) ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)
y <- log(gravel[, 7] + 1)
set.seed(1234)
glmkrigecv1 <- glmkrigecv(formula.glm = model, longlat = longlat, trainxy = gravel, y = y, transformation = "none", formula.krige = res1 ~ 1, vgm.args = "Sph", nmaxkrige = 12, validation = "CV", predacc = "ALL")
glmkrigecv1 # Since the default 'family' is used, actually a 'lm' model is used.

data(spongelonglat)
longlat <- spongelonglat[, 7:8]
model <- sponge ~ long + I(long^2)
y = spongelonglat[, 1]
set.seed(1234)
glmkrigecv1 <- glmkrigecv(formula.glm = model, longlat = longlat, trainxy = spongelonglat, y = y, family = poisson, transformation = "arcsine", formula.krige = res1 ~ 1, vgm.args = "Sph", nmaxkrige = 12, validation = "CV", predacc = "ALL")
glmkrigecv1
```

# glmok for count data
```r
data(spongelonglat)
longlat <- spongelonglat[, 7:8]
model <- sponge ~ . # use all predictive variables in the dataset
y = spongelonglat[, 1]
set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
  glmkrigecv1 <- glmkrigecv(formula.glm = model, longlat = longlat, trainxy = spongelonglat, y = y, family = poisson, formula.krige = res1 ~ 1, vgm.args = "Sph", nmaxkrige = 12, validation = "CV", predacc = "VEcv")
  VEc1[i] <- glmkrigecv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for GLM", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n), col = 2)
abline(h = mean(VEcv), col = "blue", lwd = 2)
```

# glmok for percentage data
```r
library(MASS)
longlat <- petrel[, c(1, 2)]
model <- gravel / 100 ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)
set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
```
glmkrigeidwcv

Cross validation, n-fold and leave-one-out for the hybrid methods of generalised linear models ('glm'), 'kriging' and inverse distance weighted ('IDW').

Description

This function is a cross validation function for 38 hybrid methods of 'glm', 'kriging' and 'IDW', including the average of 'glmkrige' and 'glmidw' ('glmkrigeidw') and the average of 'glm', 'glmkrige' and 'glmidw' ('glmglmkrigeidw'), where 'kriging' methods include ordinary kriging ('OK'), simple kriging ('SK'), block 'OK' ('BOK') and block 'SK' ('BSK') and 'IDW' also covers 'NN' and 'KNN' (for details, see reference #1). This function can also be sued for 38 hybrid methods of 'lm', 'kriging' and 'IDW'.

Usage

glmkrigeidwcv(
  formula.glm = NULL,
  longlat,
  trainxy,
  y,
  family = "gaussian",
  transformation = "none",
  delta = 1,
  formula.krige = res1 ~ 1,
  vgm.args = c("Sph"),
  anis = c(0, 1),
  alpha = 0,
  block = 0,
  beta,
  nmaxkrige = 12,
  idp = 2,
  nmaxidw = 12,
  hybrid.parameter = 2,
  lambda = 1,
  validation = "CV",
)
cv.fold = 10, 
  predacc = "VEcv",
  ...
)

Arguments

formula.glm  a formula defining the response variable and predictive variables for 'glm'.
longlat  a dataframe contains longitude and latitude of point samples.
trainxy  a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples.
y  a vector of the response variable in the formula, that is, the left part of the formula.
family  a description of the error distribution and link function to be used in the model. See '?glm' for details.
transformation  transform the residuals of 'glm' to normalise the data for 'krige'; can be "sqrt" for square root, "arcsine" for arcsine, "log" or "none" for non transformation. By default, "none" is used.
delta  numeric; to avoid log(0) in the log transformation. The default is 1.
formula.krige  formula defining the response vector and (possible) regressor. an object (i.e., 'variogram.formula') for 'variogram' or a formula for 'krige'. see 'variogram' and 'krige' in 'gstat' for details.
vgm.args  arguments for 'vgm', e.g. variogram model of response variable and anisotropy parameters. see 'vgm' in 'gstat' for details. By default, "Sph" is used.
anis  anisotropy parameters: see notes 'vgm' in 'gstat' for details.
alpha  direction in plane (x,y). see variogram in 'gstat' for details.
block  block size. see 'krige' in 'gstat' for details.
beta  for simple kriging. see 'krige' in 'gstat' for details.
nmax.krige  for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.
idp  a numeric number specifying the inverse distance weighting power.
nmax.idw  for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.
hybrid.parameter  the default is 2 that is for 'glmkrigeidwcv'; for 'glmglmkrigeidwcv', it needs to be 3.
lambda,  ranging from 0 to 2; the default is 1 for 'glmkrigeidwcv' and 'glmglmkrigeidwcv'; and if it is < 1, more weight is placed on 'krige', otherwise more weight is placed on 'idw'; and if it is 0, 'idw' is not considered and the resultant methods is 'glmkrige' when the default 'hybrid.parameter' is used; and if it is 2, then the resultant method is 'glmidw' when the default 'hybrid.parameter' is used.
validation methods, include 'LOO': leave-one-out, and 'CV': cross-validation.

**cv.fold**

integer; number of folds in the cross-validation. if > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.

**predacc**

can be either "VEcv" for vecv or "ALL" for all measures in function pred.acc. other arguments passed on to 'glm', 'krige' and 'gstat'.

**Value**

A list with the following components: me, rme, mae, rmae, mse, rmse, rrmse, vecv and e1; or vecv only

**Note**

This function is largely based on 'rfcv' in 'randomForest', 'krigecv' in 'spm2'and 'glm' in 'stats'.

**Author(s)**

Jin Li

**References**


**Examples**

```r
library(spm)
# glmokglidw
data(petrel)
gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
model <- log(gravel + 1) ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)
y <- log(gravel[, 7] +1)
set.seed(1234)
glmkrigetglidwcv1 <- glmkrigetglidwcv(formula.glm = model, longlat = longlat, trainxy = gravel, y = y, transformation = "none", formula.krige = res1 ~ 1, vgm.args = "Sph", nmaxkrige = 12, idp = 2, nmaxidw = 12, validation = "CV", predacc = "ALL")
glmkrigetglidwcv1 # Since the default 'family' is used, actually a 'lm' model is used.

# glmokglidw
data(spongelonglat)
longlat <- spongelonglat[, 7:8]
```
model <- sponge ~ long + I(long^2)
y = spongelonglat[, 1]
set.seed(1234)
glmkrigeidwcv1 <- glmkrigeidwcv(formula.glm = model, longlat = longlat,
trainxy = spongelonglat, y = y, family = poisson, transformation = "arcsine",
formula.krige = res1 ~ 1, vgm.args = ("Sph"), nmaxkrige = 12, idp = 2,
nmaxidw = 12, validation = "CV", predacc = "ALL")
glmkrigeidwcv1

# glmglmokglmidw
data(spongelonglat)
longlat <- spongelonglat[, 7:8]
model <- sponge ~ long + I(long^2)
y = spongelonglat[, 1]
set.seed(1234)
glmglmkrigeidwcv1 <- glmkrigeidwcv(formula.glm = model, longlat = longlat,
trainxy = spongelonglat, y = y, family = poisson, transformation = "arcsine",
formula.krige = res1 ~ 1, vgm.args = ("Sph"), nmaxkrige = 12, idp = 2,
nmaxidw = 12, hybrid.parameter = 3, validation = "CV", predacc = "ALL")
glmglmkrigeidwcv1

# glmokglmidw for count data
data(spongelonglat)
longlat <- spongelonglat[, 7:8]
model <- sponge ~ . # use all predictive variables in the dataset
y = spongelonglat[, 1]
set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
glmkrigeidwcv1 <- glmkrigeidwcv(formula.glm = model, longlat = longlat,
trainxy = spongelonglat, y = y, family = poisson, transformation = "arcsine",
formula.krige = res1 ~ 1, vgm.args = ("Sph"), nmaxkrige = 12, idp = 2,
nmaxidw = 12, validation = "CV", predacc = "VEcv")
VEcv [i] <- glmkrigeidwcv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for GLM", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) ~ c(1:n), col = 2)
abline(h = mean(VEcv), col = "blue", lwd = 2)

# glmokglmidw for percentage data
library(MASS)
longlat <- petrel[, c(1, 2)]
model <- gravel / 100 ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)
set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
glmkrigeidwcv1 <- glmkrigeidwcv(formula.glm = model, longlat = longlat,
trainxy = gravel, y = gravel[, 7] / 100, family = binomial(link=logit),
formula.krige = res1 ~ 1, vgm.args = ("Sph"), nmaxkrige = 12, idp = 2,
nmaxidw = 12, validation = "CV", predacc = "VEcv")
VEcv [i] <- glmkrigeidwcv1
glmkrigeidwpred

Generate spatial predictions using the hybrid methods of generalised linear models ('glm'), 'kriging' and inverse distance weighted ('IDW').

Description

This function is for generating spatial predictions using the hybrid methods of 'glm', 'kriging' and 'IDW', including all methods implemented in 'glmkrigeidwcv'.

Usage

```r
glmkrigeidwpred(
  formula.glm = NULL,
  longlat,
  trainxy,
  predx,
  y,
  longlatpredx,
  family = "gaussian",
  transformation = "none",
  delta = 1,
  formula.krige = res1 ~ 1,
  vgm.args = c("Sph"),
  anis = c(0, 1),
  alpha = 0,
  block = 0,
  beta,
  nmaxkrige = 12,
  idp = 2,
  nmaxidw = 12,
  hybrid.parameter = 2,
  lambda = 1,
  ...
)
```

Arguments

- `formula.glm` a formula defining the response variable and predictive variables for 'glm'.
- `longlat` a dataframe contains longitude and latitude of point samples.
glmkrigeidwpred

trainxy  a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples.

predx  a dataframe or matrix contains columns of predictive variables for the grids to be predicted.

y  a vector of the response variable in the formula, that is, the left part of the formula.

longlatpredx  a dataframe contains longitude and latitude of point locations (i.e., the centers of grids) to be predicted.

family  a description of the error distribution and link function to be used in the model. See '?glm' for details.

transformation  transform the residuals of 'glm' to normalise the data; can be "sqrt" for square root, "arcsine" for arcsine, "log" or "none" for non transformation. By default, "none" is used.

delta  numeric; to avoid log(0) in the log transformation. The default is 1.

formula.krige  formula defining the response vector and (possible) regressor. an object (i.e., 'variogram.formula') for 'variogram' or a formula for 'krige'. see 'variogram' and 'krige' in 'gstat' for details.

vgm.args  arguments for 'vgm', e.g. variogram model of response variable and anisotropy parameters. see 'vgm' in 'gstat' for details. By default, "Sph" is used.

anis  anisotropy parameters: see notes 'vgm' in 'gstat' for details.

alpha  direction in plane (x,y). see variogram in 'gstat' for details.

block  block size. see 'krige' in 'gstat' for details.

beta  for simple kriging. see 'krige' in 'gstat' for details.

nmaxkrige  for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

idp  a numeric number specifying the inverse distance weighting power.

nmaxidw  for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

hybrid.parameter  the default is 2 that is for 'glmkrigeglmidw'; for 'glmglmkrigeglmidw', it needs to be 3.

lambda,  ranging from 0 to 2; the default is 1 for 'glmkrigeglmidw' and 'glmglmkrigeglmidw'; and if it is < 1, more weight is placed on 'krige', otherwise more weight is placed on 'idw'; and if it is 0, 'idw' is not considered and the resultant methods is 'glmkrige' when the default 'hybrid.parameter' is used; and if it is 2, then the resultant method is 'glmidw' when the default 'hybrid.parameter' is used.

...  other arguments passed on to 'glm', 'krige' and 'gstat'.

Value

A dataframe of longitude, latitude, and predictions.
Author(s)
Jin Li

References


Examples

```r
library(spm)

data(petrel)
data(petrel.grid)

gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
model <- log(gravel + 1) ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)
y <- log(gravel[, 7] +1)

glmkrigeidwpred1 <- glmkrigeidwpred(formula.glm = model, longlat = longlat, trainxy = gravel, predx = petrel.grid, y = y, longlatpredx = petrel.grid[, c(1:2)], formula.krige = res1 ~ 1, vgm.args = "Sph", nmaxkrige = 12, idp = 2, nmaxidw = 12)
# Since the default 'family' is used, actually a 'lm' model is used.
names(glmkrigeidwpred1)

# Back transform 'glmkrigeidwpred$predictions' to generate the final predictions
glmkrigeidw.predictions <- exp(glmkrigeidwpred1$predictions) - 1
range(glmkrigeidw.predictions)
```

---

**glmkrigepred**

*Generate spatial predictions using the hybrid method of generalised linear models ('glm') and 'krige'*

**Description**

This function is for generating spatial predictions using the hybrid method of 'glm' and 'krige', including all methods implemented in 'glmkrigecv'. (see reference #1 for further info).
Usage

glmkrigepred(
  formula.glm = NULL,
  longlat,
  trainxy,
  predx,
  y,
  longlatpredx,
  family = "gaussian",
  transformation = "none",
  delta = 1,
  formula.krige = res1 ~ 1,
  vgm.args = c("Sph"),
  anis = c(0, 1),
  alpha = 0,
  block = 0,
  beta,
  nmaxkrige = 12,
  ...
)

Arguments

formula.glm a formula defining the response variable and predictive variables for 'glm'.
longlat a dataframe contains longitude and latitude of point samples.
trainxy a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples.
predx a dataframe or matrix contains columns of predictive variables for the grids to be predicted.
y a vector of the response variable in the formula, that is, the left part of the formula.
longlatpredx a dataframe contains longitude and latitude of point locations (i.e., the centers of grids) to be predicted.
family a description of the error distribution and link function to be used in the model. See '?glm' for details.
transformation transform the residuals of 'glm' to normalise the data; can be "sqrt" for square root, "arcsine" for arcsine, "log" or "none" for non transformation. By default, "none" is used.
delta numeric; to avoid log(0) in the log transformation. The default is 1.
formula.krige formula defining the response vector and (possible) regressor. an object (i.e., 'variogram.formula') for 'variogram' or a formula for 'krige'. see 'variogram' and 'krige' in 'gstat' for details.
vgm.args arguments for 'vgm', e.g. variogram model of response variable and anisotropy parameters. see 'vgm' in 'gstat' for details. By default, "Sph" is used.
anis anisotropy parameters: see notes 'vgm' in 'gstat' for details.
alpha
direction in plane (x,y). see variogram in 'gstat' for details.

block
block size. see 'krige' in 'gstat' for details.

beta
for simple kriging. see 'krige' in 'gstat' for details.

nmaxkrige
for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

... other arguments passed on to 'glm' and 'krige'.

Value
A dataframe of longitude, latitude, and predictions.

Author(s)
Jin Li

References


Examples

library(spm)

data(petrel)
data(petrel.grid)

gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
model <- log(gravel + 1) ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)
y <- log(gravel[, 7] + 1)

glmkrigepred1 <- glmkrigepred(formula.glm = model, longlat = longlat, trainxy = gravel, predx = petrel.grid, y = y, longlatpredx = petrel.grid[, c(1:2)], transformation = "none", formula.krige = res1 ~ 1, vgm.args = "Sph", nmaxkrige = 12)
# Since the default 'family' is used, actually a 'lm' model is used.

names(glmkrigepred1)

# Back transform 'glmkrigepred$predictions' to generate the final predictions
glmkrige.predictions <- exp(glmkrigepred1$predictions) - 1
range(glmkrige.predictions)
glmnetcv

Cross validation, n-fold and leave-one-out, for 'glmnet' in 'glmnet' package

Description

This function is a cross validation function for 'glmnet' method in 'glmnet' package.

Usage

glmnetcv(
  trainx,
  y,
  family = "gaussian",
  alpha = 0.5,
  relax = FALSE,
  type.measure = "mse",
  validation = "CV",
  cv.fold = 10,
  predacc = "VEcv",
  ...
)

Arguments

trainx a matrix contains predictive variables of point samples. The location information, longitude (long), latitude (lat), need to be included in the 'trainx' for spatial predictive modelling.

y a vector of the response variable in the formula, that is, the left part of the formula.

family a description of the error distribution and link function to be used in the model. See '?glmnet' for details.

alpha, an elasticnet mixing parameter, with $0 \leq alpha \leq 1$. See '?glmnet' for details.

relax, if TRUE then for each active set in the path of solutions, the model is refit without any regularization. See '?glmnet' for more details.

type.measure, loss to use for cross-validation. The default is type.measure="mse". See '?cv.glmnet' for more information.

validation validation methods, include 'LOO': leave-one-out, and 'CV': cross-validation.

cv.fold integer; number of folds in the cross-validation. if > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.

predacc can be either "VEcv" for vecv or "ALL" for all measures in function pred.acc.

... other arguments passed on to 'fields'.
glmnetcv

Value

A list with the following components: me, rme, mae, rmae, mse, rmse, rrmse, vecv and e1; or vecv only

Note

This function is largely based on 'glmcv' in this 'spm2' package.

Author(s)

Jin Li

References


Examples

library(spm)

data(petrel)
x <- as.matrix(petrel[, c(1, 2, 6:9)])
y <- log(petrel[, 5] + 1)
set.seed(1234)
glmnetcv1 <- glmnetcv(x, y, validation = "CV", predacc = "ALL")
glmnetcv1

data(sponge)
x <- as.matrix(cbind(sponge$easting, sponge$easting^2))
set.seed(1234)
glmnetcv1 <- glmnetcv(x, sponge[, 3], family = poisson, validation = "CV", predacc = "ALL")
glmnetcv1

# For glmnet with gaussian
x <- as.matrix(petrel[, c(1, 2, 6:9)])
y <- log(petrel[, 5] + 1)
set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
  glmnetcv1 <- glmnetcv(x, y, validation = "CV", predacc = "VEcv")
  VEcv[i] <- glmnetcv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for glmnet", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) - c(1:n), col = 2)
abline(h = mean(VEcv), col = "blue", lwd = 2)

# For glmnet with binomial
x <- as.matrix(cbind(petrel[, c(2, 6)], petrel$long^3, petrel$lat^2, petrel$lat^3))
set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
  glmnetcv1 <- glmnetcv(x, petrel[, 5] / 100, family = binomial(link=logit),
                        validation = "CV", predacc = "VEcv")
  VEcv[i] <- glmnetcv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for glmnet", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) ~ c(1:n), col = 2)
abline(h = mean(VEcv), col = "blue", lwd = 2)

---

**glmpred**

*Generate spatial predictions using generalised linear models ('glm')*

**Description**

This function is for generating spatial predictions using 'glm' method in 'stats' package.

**Usage**

```r
glmpred(formula = NULL, trainxy, longlatpredx, predx, family = "gaussian", ...)
```

**Arguments**

- **formula**
  - a formula defining the response variable and predictive variables.
- **trainxy**
  - a dataframe contains predictive variables and the response variable of point samples. The location information, longitude (long), latitude (lat), need to be included in the 'trainx' for spatial predictive modeling, need to be named as 'long' and 'lat'.
- **longlatpredx**
  - a dataframe contains longitude and latitude of point locations (i.e., the centers of grids) to be predicted.
- **predx**
  - a dataframe or matrix contains columns of predictive variables for the grids to be predicted.
- **family**
  - a description of the error distribution and link function to be used in the model. See '?glm' for details.
- **...**
  - other arguments passed on to 'glm'.

**Value**

A dataframe of longitude, latitude and predictions.

**Author(s)**

Jin Li
Examples

```r
library(spm)
data(petrel)
data(petrel.grid)

gravel <- petrel[, c(1, 2, 6:9, 5)]
model <- log(gravel + 1) ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)

glmpred1 <- glmpred(formula = model, trainxy = gravel, longlatpredx = petrel.grid[, c(1:2)], predx = petrel.grid)

names(glmpred1)

# Back transform 'glmpred1$pred.glml' to generate the final predictions
glm.predictions <- exp(glmpred1$pred.glml) - 1
range(glm.predictions)
```

---

**glscv**

*Cross validation, n-fold and leave-one-out for generalized least squares ('gls')*

**Description**

This function is a cross validation function for 'gls' method in 'nlme' package.

**Usage**

```r
glscv(
  model = var1 ~ 1,
  trainxy,
  y,
  corr.args = NULL,
  weights = NULL,
  validation = "CV",
  cv.fold = 10,
  predacc = "VEcv",
  ...
)
```

**Arguments**

- `model`: a formula defining the response variable and predictive variables.
- `trainxy`: a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples. That is, the location information must be names as 'long' and 'lat'.
glscv

y a vector of the response variable in the formula, that is, the left part of the formula.
corr.args arguments for ‘correlation’ in ‘gls’. See ‘?corClasses’ in ‘nlme’ for details. By default, “NULL” is used. When "NULL" is used, then 'gls' is actually performing 'lm'.
weights describing the within-group heteroscedasticity structure. Defaults to "NULL", corresponding to homoscedastic errors. See ‘?gls’ in ‘nlme’ for details.
validation validation methods, include 'LOO': leave-one-out, and 'CV': cross-validation.
cv.fold integer; number of folds in the cross-validation. If > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.
predacc can be either "VEcv" for vecv or "ALL" for all measures in function pred.acc.
... other arguments passed on to ‘gls’.

Value

A list with the following components: me, rme, mae, rmae, mse, rmse, vecv and e1; or vecv only.

Note

This function is largely based on rfcv in ‘randomForest’ and ‘gls’ in ‘library(nlme)’.

Author(s)

Jin Li

References


Examples

```r
library(spm)
library(nlme)
data(petrel)
gravel <- petrel[, c(1, 2, 6:9, 5)]
range1 <- 0.8
nugget1 <- 0.5
model <- log(gravel + 1) ~ long + lat + bathy + dist + I(long^2) + I(lat^2) + I(lat^3) + I(bathy^2) + I(bathy^3) + I(dist^2) + I(dist^3) + I(relief^2) + I(relief^3)
glscv1 <- glscv(model = model, gravel, log(gravel[, 7] +1), validation = "CV",
corr.args = corSpher(c(range1, nugget1), form = ~ long + lat, nugget = T),
predacc = "ALL")
```
Cross validation, n-fold and leave-one-out for the hybrid method of generalized least squares (‘gls’) and inverse distance weighted (‘idw’)

Description

This function is a cross validation function for the hybrid method of ‘gls’ and ‘idw’, where the data splitting is based on a stratified random sampling method (see the ‘datasplit’ function for details)

Usage

```r
library(glsidwcv)

glsidwcv(
  model = var1 ~ 1,
  longlat,
  trainxy,
  y,
  corr.args = NULL,
  ...)
glsidwcv

```r
weights = NULL,
idp = 2,
nmaxidw = 12,
validation = "CV",
cv.fold = 10,
predacc = "VEcv",
...
)
```

**Arguments**

- `model` a formula defining the response variable and predictive variables.
- `longlat` a dataframe contains longitude and latitude of point samples.
- `trainxy` a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples. That is, the location information must be names as 'long' and 'lat'.
- `y` a vector of the response variable in the formula, that is, the left part of the formula.
- `corr.args` arguments for 'correlation' in 'gls'. See `?corClasses` in `nlme` for details. By default, "NULL" is used. When "NULL" is used, then 'gls' is actually performing 'lm'.
- `weights` describing the within-group heteroscedasticity structure. Defaults to "NULL", corresponding to homoscedastic errors. See `?gls` in `nlme` for details.
- `idp` a numeric number specifying the inverse distance weighting power.
- `nmaxidw` for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.
- `validation` validation methods, include 'LOO': leave-one-out, and 'CV': cross-validation.
- `cv.fold` integer; number of folds in the cross-validation. if > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.
- `predacc` can be either "VEcv" for vecv or "ALL" for all measures in function pred.acc.
- `...` other arguments passed on to 'gls' and 'gstat'.

**Value**

A list with the following components: me, rme, mae, rmae, mse, rmse, rrmse, vecv and e1; or vecv only.

**Note**

This function is largely based on rfcv in 'randomForest' and 'gls' in 'library(nlme)'.

**Author(s)**

Jin Li
References


Examples

```r
library(spm)
library(nlme)

data(petrel)
gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
range1 <- 0.8
nugget1 <- 0.5
model <- log(gravel + 1) ~ long + lat + bathy + dist + I(long^2) + I(lat^2) + I(lat^3) + I(bathy^2) + I(bathy^3) + I(dist^2) + I(dist^3) + I(relief^2) + I(relief^3)

glsidwcv1 <- glsidwcv(model = model, longlat = longlat, trainxy = gravel, y = log(gravel[, 7] + 1), idp = 2, nmaxidw = 12, validation = "CV", corr.args = corSpher(c(range1, nugget1), form = ~ lat + long, nugget = T), predacc = "ALL")
glsidwcv1
```

# For glsidw
set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
glsidwcv1 <- glsidwcv(model = model, longlat = longlat, trainxy = gravel, y = log(gravel[, 7] + 1), idp = 2, nmaxidw = 12, validation = "CV", corr.args = corSpher(c(range1, nugget1), form = ~ lat + long, nugget = T), predacc = "VEcv")
VEcv[i] <- glsidwcv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for GLSIDW", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) ~ c(1:n), col = 2)
abline(h = mean(VEcv), col = "blue", lwd = 2)
```

---

**glsidwpred**

Generate spatial predictions using the hybrid method of generalized least squares ('gls') and inverse distance weighted ('IDW') ('glsidw')
Description

This function is for generating spatial predictions using the hybrid method of 'gls' and 'idw' ('glsidw') (see reference #1).

Usage

glsidwpred(
  model = var1 ~ 1,
  longlat,
  trainxy,
  y,
  longlatpredx,
  predx,
  corr.args = NULL,
  weights = NULL,
  idp = 2,
  nmaxidw = 12,
  ...
)

Arguments

model  a formula defining the response variable and predictive variables.
longlat a dataframe contains longitude and latitude of point samples.
trainxy a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples. That is, the location information must be names as 'long' and 'lat'.
y     a vector of the response variable in the formula, that is, the left part of the formula.
longlatpredx a dataframe contains longitude and latitude of point locations (i.e., the centers of grids) to be predicted. The location information must be named as 'long' and 'lat'.
predx  a dataframe or matrix contains columns of predictive variables for the grids to be predicted.
corr.args arguments for 'correlation' in 'gls'. See '?corClasses' in 'nlme' for details. By default, "NULL" is used. When "NULL" is used, then 'gls' is actually performing 'lm'.
weights describing the within-group heteroscedasticity structure. Defaults to "NULL", corresponding to homoscedastic errors. See '?gls' in 'nlme' for details.
idp    a numeric number specifying the inverse distance weighting power.
nmaxidw for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.
...    other arguments passed on to 'gls' and 'gstat'.
Value

A dataframe of longitude, latitude, and predictions.

Author(s)

Jin Li

References


Examples

```r
library(spm)
library(nlme)

data(petrel)
data(petrel.grid)

gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
range1 <- 0.8
nugget1 <- 0.5
model <- log(gravel + 1) ~ long + lat + bathy + dist + I(long^2) + I(lat^2) + 
I(lat^3) + I(bathy^2) + I(bathy^3) + I(dist^2) + I(dist^3) + I(relief^2) + I(relief^3)
y <- log(gravel[, 7] + 1)

# Back transform 'glsidw$predictions' to generate the final predictions
names(glsidw)
glsidw.predictions <- exp(glsidw$predictions) - 1
range(glsidw.predictions)
```

**glskrigecv**

Cross validation, n-fold and leave-one-out for the hybrid method of generalized least squares ('gls') and kriging ('krige') ('glskrige')
Description

This function is a cross validation function for the hybrid method of 'gls' and 'krige' ('glskrige'), where the data splitting is based on a stratified random sampling method (see the 'datasplit' function for details).

Usage

```r
glskrigecv(
    model = var1 ~ 1,
    longlat,
    trainxy,
    y,
    corr.args = NULL,
    weights = NULL,
    transformation = "none",
    delta = 1,
    formula.krige = res1 ~ 1,
    vgm.args = c("Sph"),
    anis = c(0, 1),
    alpha = 0,
    block = 0,
    beta,
    nmaxkrige = 12,
    validation = "CV",
    cv.fold = 10,
    predacc = "VEcv",
    ...
)
```

Arguments

<table>
<thead>
<tr>
<th>Argument</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td><code>model</code></td>
<td>a formula defining the response variable and predictive variables.</td>
</tr>
<tr>
<td><code>longlat</code></td>
<td>a dataframe contains longitude and latitude of point samples.</td>
</tr>
<tr>
<td><code>trainxy</code></td>
<td>a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples. That is, the location information must be names as 'long' and 'lat'.</td>
</tr>
<tr>
<td><code>y</code></td>
<td>a vector of the response variable in the formula, that is, the left part of the formula.</td>
</tr>
<tr>
<td><code>corr.args</code></td>
<td>arguments for 'correlation' in 'gls'. See '?corClasses' in 'nlme' for details. By default, &quot;NULL&quot; is used. When &quot;NULL&quot; is used, then 'gls' is actually performing 'lm'.</td>
</tr>
<tr>
<td><code>weights</code></td>
<td>describing the within-group heteroscedasticity structure. Defaults to &quot;NULL&quot;, corresponding to homoscedastic errors. See '?gls' in 'nlme' for details.</td>
</tr>
<tr>
<td><code>transformation</code></td>
<td>transform the residuals of 'gls' to normalize the data; can be &quot;sqrt&quot; for square root, &quot;arcsine&quot; for arcsine, &quot;log&quot; or &quot;none&quot; for non transformation. By default, &quot;none&quot; is used.</td>
</tr>
</tbody>
</table>
delta numeric; to avoid log(0) in the log transformation. The default is 1.

formula.krige formula defining the response vector and (possible) regressor. an object (i.e., 'variogram.formula') for 'variogram' or a formula for 'krige'. see 'variogram' and 'krige' in 'gstat' for details.

vgm.args arguments for 'vgm', e.g. variogram model of response variable and anisotropy parameters. see 'vgm' in 'gstat' for details. By default, "Sph" is used.

anis anisotropy parameters: see notes 'vgm' in 'gstat' for details.

alpha direction in plane (x,y). see variogram in 'gstat' for details.

block block size. see 'krige' in 'gstat' for details.

beta for simple kriging. see 'krige' in 'gstat' for details.

nmaxkrige for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

validation validation methods, include 'LOO': leave-one-out, and 'CV': cross-validation.

cv.fold integer; number of folds in the cross-validation. if > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.

predacc can be either "VEcv" for vecv or "ALL" for all measures in function pred.acc.

... other arguments passed on to 'gls' and 'krige'.

Value

A list with the following components: me, rme, mae, rmae, mse, rmse, rrmse, vecv and e1; or vecv only.

Note

This function is largely based on rfcv in 'randomForest', 'krigecv' in 'spm2' and 'gls' in 'library(nlme').

Author(s)

Jin Li

References


Examples

library(spm)
library(nlme)
data(petrel)
gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
range1 <- 0.8
nugget1 <- 0.5
model <- log(gravel + 1) ~ long + lat + bathy + dist + I(long^2) + I(lat^2) +
I(lat^3) + I(bathy^2) + I(bathy^3) + I(dist^2) + I(dist^3) + I(relief^2) + I(relief^3)
glskrigecv1 <- glskrigecv(model = model, longlat = longlat, trainxy = gravel,
y = log(gravel[, 7] + 1), transformation = "none", formula.krige = res1 ~ 1,
vgm.args = "Sph", nmaxkrige = 12, validation = "CV",
corr.args = corSpher(c(range1, nugget1), form = ~ lat + long, nugget = T),
predacc = "ALL")
glskrigecv1

# For glskrige
set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
glskrigecv1 <- glskrigecv(model = model, longlat = longlat, trainxy = gravel,
y = log(gravel[, 7] + 1), transformation = "none", formula.krige = res1 ~ 1,
vgm.args = "Sph", nmaxok = 12, validation = "CV",
corr.args = corSpher(c(range1, nugget1), form = ~ lat + long, nugget = T),
predacc = "VEcv")
VEcv[i] <- glskrigecv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for GLSOV", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) ~ c(1:n), col = 2)
abline(h = mean(VEcv), col = "blue", lwd = 2)

---

glskrigeidwcv

cross validation, n-fold and leave-one-out for the hybrid methods of gln, kriging and inverse distance weighted (IDW)

Description

This function is a cross validation function for 38 hybrid methods of 'gls', 'kriging' and 'IDW', including the average of 'glskrige' and 'glsidw' ('glskrigeglsidw') and the average of 'gls', 'glskrige' and 'glsidw' ('glsiglskrigeglsidw'), where 'kriging' methods include ordinary kriging ('OK'), simple kriging ('SK'), block 'OK' ('BOK') and block 'SK' ('BSK') and 'IDW' also covers 'NN' and 'KNN'. The data splitting is based on a stratified random sampling method (see the 'datasplit' function for details).

Usage

glskrigeidwcv(
model = var1 ~ 1,
longlat,
trainxy,
y,
corr.args = NULL,
weights = NULL,
transformation = "none",
delta = 1,
formula.krige = res1 ~ 1,
vgm.args = c("Sph"),
anis = c(0, 1),
alpha = 0,
block = 0,
beta,
nmaxkrige = 12,
idp = 2,
nmaxidw = 12,
hybrid.parameter = 2,
lambda = 1,
validation = "CV",
cv.fold = 10,
predacc = "VEcv",
...
}

Arguments

model a formula defining the response variable and predictive variables.
longlat a dataframe contains longitude and latitude of point samples.
trainxy a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples. That is, the location information must be names as 'long' and 'lat'.
y a vector of the response variable in the formula, that is, the left part of the formula.
corr.args arguments for 'correlation' in 'gls'. See '?corClasses' in 'nlme' for details. By default, "NULL" is used. When "NULL" is used, then 'gls' is actually performing 'lm'.
weights describing the within-group heteroscedasticity structure. Defaults to "NULL", corresponding to homoscedastic errors. See '?gls' in 'nlme' for details.
transformation transform the residuals of 'gls' to normalise the data for 'krige'; can be "sqrt" for square root, "arcsine" for arcsine, "log" or "none" for non transformation. By default, "none" is used.
delta numeric; to avoid log(0) in the log transformation. The default is 1.
formula.krige formula defining the response vector and (possible) regressor. an object (i.e., 'variogram.formula') for 'variogram' or a formula for 'krige'. see 'variogram' and 'krige' in 'gstat' for details.
vgm.args arguments for 'vgm', e.g. variogram model of response variable and anisotropy parameters. see 'vgm' in 'gstat' for details. By default, "Sph" is used.

anis anisotropy parameters: see notes 'vgm' in 'gstat' for details.

alpha direction in plane (x,y). see variogram in 'gstat' for details.

block block size. see 'krige' in 'gstat' for details.

beta for simple kriging. see 'krige' in 'gstat' for details.

nmaxkrige for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

idp a numeric number specifying the inverse distance weighting power.

nmaxidw for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

hybrid.parameter

the default is 2 that is for 'glskrigeglsidw'; for 'glsglskrigeglsidw', it needs to be 3.

lambda, ranging from 0 to 2; the default is 1 for 'glskrigeglsidw' and 'glsglskrigeglsidw'; and if it is < 1, more weight is placed on 'krige', otherwise more weight is placed on 'idw'; and if it is 0, 'idw' is not considered and the resultant methods is 'glskrige' when the default 'hybrid.parameter' is used; and if it is 2, then the resultant method is 'glsidw' when the default 'hybrid.parameter' is used.

validation validation methods, include 'LOO': leave-one-out, and 'CV': cross-validation.

cv.fold integer; number of folds in the cross-validation. if > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.

predacc can be either "VEcv" for vecv or "ALL" for all measures in function pred.acc.

... other arguments passed on to 'gls', 'krige' and 'gstat'.

Value

A list with the following components: me, rme, mae, rmae, mse, rmse, rrmse, vecv and e1; or vecv only.

Note

This function is largely based on rfcv in 'randomForest', 'krigecv' in 'spm2' and 'gls' in 'library(nlme)'.

Author(s)

Jin Li

References


Examples

```r
library(spm)
library(nlme)

data(petrel)
gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
rangle <- 0.8
nugget1 <- 0.5
model <- log(gravel + 1) ~ long + lat + bathy + dist + I(long^2) + I(lat^2) + I(lat^3) + I(bathy^2) + I(bathy^3) + I(dist^2) + I(dist^3) + I(relief^2) + I(relief^3)

glskrigeidwcv1 <- glskrigeidwcv(model = model, longlat = longlat, trainxy = gravel, y = log(gravel[, 7] + 1), transformation = "none", formula.krige = res1 ~ 1, vgm.args = "Sph", nmaxkrige = 12, idp = 2, nmaxidw = 12, validation = "CV", corr.args = corSpher(c(rangle, nugget1), form = ~ lat + long, nugget = T), predacc = "ALL")
glskrigeidwcv1

# For glskrigeglsidw
set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
glskrigeidwcv1 <- glskrigeidwcv(model = model, longlat = longlat, trainxy = gravel, y = log(gravel[, 7] + 1), transformation = "none", formula.krige = res1 ~ 1, vgm.args = "Sph", nmaxkrige = 12, idp = 2, nmaxidw = 12, validation = "CV", corr.args = corSpher(c(rangle, nugget1), form = ~ lat + long, nugget = T), predacc = "VEcv")
VEcv[i] <- glskrigeidwcv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for GLSOKGLSIDW", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) ~ c(1:n), col = 2)
abline(h = mean(VEcv), col = "blue", lwd = 2)

# For glsnglskrigeidw
set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
glskrigeidwcv1 <- glskrigeidwcv(model = model, longlat = longlat, trainxy = gravel, y = log(gravel[, 7] + 1), transformation = "none", formula.krige = res1 ~ 1, vgm.args = "Sph", nmaxkrige = 12, idp = 2, nmaxidw = 12, hybrid.parameter = 3, validation = "CV", corr.args = corSpher(c(rangle, nugget1), form = ~ lat + long, nugget = T), predacc = "VEcv")
VEcv[i] <- glskrigeidwcv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for GLSOKGLSIDW", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) ~ c(1:n), col = 2)
abline(h = mean(VEcv), col = "blue", lwd = 2)
```
glskrigeidwpred

Generate spatial predictions using the hybrid methods of generalised least squares (‘gls’), ‘kriging’ and inverse distance weighted (‘IDW’)

Description

This function is for generating spatial predictions using the hybrid methods of ‘gls’, ‘kriging’ and ‘IDW’, including all methods implemented in ‘glskrigeidwcv’.

Usage

```r
glskrigeidwpred(
  model = var1 ~ 1,
  longlat,
  trainxy,
  predx,
  y,
  longlatpredx,
  corr.args = NULL,
  weights = NULL,
  transformation = "none",
  delta = 1,
  formula.krige = res1 ~ 1,
  vgm.args = c("Sph"),
  anis = c(0, 1),
  alpha = 0,
  block = 0,
  beta,
  nmaxkrige = 12,
  idp = 2,
  nmaxidw = 12,
  hybrid.parameter = 2,
  lambda = 1,
  ...
)
```

Arguments

- `model` a formula defining the response variable and predictive variables.
- `longlat` a dataframe contains longitude and latitude of point samples.
- `trainxy` a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples. That is, the location information must be names as 'long' and 'lat'.
predx a dataframe or matrix contains columns of predictive variables for the grids to be predicted.
y a vector of the response variable in the formula, that is, the left part of the formula.
longlatpredx a dataframe contains longitude and latitude of point locations (i.e., the centers of grids) to be predicted. The location information must be named as 'long' and 'lat'.
corr.args arguments for 'correlation' in 'gls'. See '?corClasses' in 'nlme' for details. By default, "NULL" is used. When "NULL" is used, then 'gls' is actually performing 'lm'.
weights describing the within-group heteroscedasticity structure. Defaults to "NULL", corresponding to homoscedastic errors. See '?gls' in 'nlme' for details.
transformation transform the residuals of 'gls' to normalise the data for 'krige'; can be "sqrt" for square root, "arcsin" for arcsin, "log" or "none" for non transformation. By default, "none" is used.
delta numeric; to avoid log(0) in the log transformation. The default is 1.
formula.krige formula defining the response vector and (possible) regressor. an object (i.e., 'variogram.formula') for 'variogram' or a formula for 'krige'. see 'variogram' and 'krige' in 'gstat' for details.
vgm.args arguments for 'vgm', e.g. variogram model of response variable and anisotropy parameters. see '?vgm' in 'gstat' for details. By default, 'Sph' is used.
anis anisotropy parameters: see notes 'vgm' in 'gstat' for details.
alpha direction in plane (x,y). see variogram in 'gstat' for details.
block block size. see 'krige' in 'gstat' for details.
beta for simple kriging. see 'krige' in 'gstat' for details.
nmaxkrige for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.
idp a numeric number specifying the inverse distance weighting power.
nmaxidw for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.
hybrid.parameter
  the default is 2 that is for 'glskrigeidw'; for 'glsglskrigeidw', it needs to be 3.
lambda, ranging from 0 to 2; the default is 1 for 'glskrigeidw' and 'glsglskrigeidw'; and if it is < 1, more weight is placed on 'krige', otherwise more weight is placed on 'idw'; and if it is 0, 'idw' is not considered and the resultant methods is 'glskrige' when the default 'hybrid.parameter' is used; and if it is 2, then the resultant method is 'glsidw' when the default 'hybrid.parameter' is used.
other arguments passed on to 'gls', 'krige' and 'gstat'.

Value
A dataframe of longitude, latitude, and predictions.
glskrigepred

Author(s)
Jin Li

References

Examples

library(spm)
library(nlme)
data(petrel)
data(petrel.grid)

gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
range1 <- 0.8
nugget1 <- 0.5
model <- log(gravel + 1) ~ long + lat + bathy + dist + I(long^2) + I(lat^2) + 
I(lat^3) + I(bathy^2) + I(bathy^3) + I(dist^2) + I(dist^3) + I(relief^2) + I(relief^3)
y <- log(gravel[, 7] +1)

glskrigeidwpred1 <- glskrigeidwpred(model = model, longlat = longlat, trainxy = gravel,
predx = petrel.grid, y = y, longlatpredx = petrel.grid[, c(1:2)],
transformation = "none", formula.krige = res1 ~ 1, vgm.args = "Sph", nmaxkrige = 12,
idp = 2, nmaxidw = 12, corr.args = corSpher(c(range1, nugget1),
form = ~ lat + long, nugget = T))
names(glskrigeidwpred1)

# Back transform 'glskrigeidwpred$predictions' to generate the final predictions

glskrigeidw.predictions <- exp(glskrigeidwpred1$predictions) - 1
range(glskrigeidw.predictions)

---

glskrigepred  Generate spatial predictions using the hybrid method of generalized
least squares ('gls') and kriging ('krige') ('glskrige')

Description

This function is for generating spatial predictions using the hybrid method of 'gls' and 'krige' 
(glskrige).
Usage

glskrigepred(
  model = var1 ~ 1,
  longlat,
  trainxy,
  predx,
  y,
  longlatpredx,
  corr.args = NULL,
  weights = NULL,
  transformation = "none",
  delta = 1,
  formula.krige = res1 ~ 1,
  vgm.args = c("Sph"),
  anis = c(0, 1),
  alpha = 0,
  block = 0,
  beta,
  nmaxkrige = 12,
...
)

Arguments

model a formula defining the response variable and predictive variables.
longlat a dataframe contains longitude and latitude of point samples.
trainxy a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples. That is, the location information must be names as 'long' and 'lat'.
predx a dataframe or matrix contains columns of predictive variables for the grids to be predicted.
y a vector of the response variable in the formula, that is, the left part of the formula.
longlatpredx a dataframe contains longitude and latitude of point locations (i.e., the centers of grids) to be predicted. The location information must be named as 'long' and 'lat'.
corr.args arguments for 'correlation' in 'gls'. See '?corClasses' in 'nlme' for details. By default, "NULL" is used. When "NULL" is used, then 'gls' is actually performing 'lm'.
weights describing the within-group heteroscedasticity structure. Defaults to "NULL", corresponding to homoscedastic errors. See '?gls' in 'nlme' for details.
transformation transform the residuals of 'gls' to normalize the data; can be "sqrt" for square root, "arcsine" for arcsine, "log" or "none" for non transformation. By default, "none" is used.
delta numeric; to avoid log(0) in the log transformation. The default is 1.
`formula.krige` formula defining the response vector and (possible) regressor. an object (i.e., 'variogram.formula') for 'variogram' or a formula for 'krige'. see 'variogram' and 'krige' in 'gstat' for details.

`vgm.args` arguments for 'vgm', e.g. variogram model of response variable and anisotropy parameters. see 'vgm' in 'gstat' for details. By default, "Sph" is used.

`anis` anisotropy parameters: see notes 'vgm' in 'gstat' for details.

`alpha` direction in plane (x,y). see variogram in 'gstat' for details.

`block` block size, see 'krige' in 'gstat' for details.

`beta` for simple kriging, see 'krige' in 'gstat' for details.

`nmaxkrige` for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

... other arguments passed on to 'gls' and 'krige'.

**Value**

A dataframe of longitude, latitude, and predictions.

**Author(s)**

Jin Li

**References**


**Examples**

```r
library(spm)
library(nlme)

data(petrel)
data(petrel.grid)

gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
gravel[1] <- 0.8
nugget1 <- 0.5
model <- log(gravel + 1) ~ long + lat + bathy + dist + I(long^2) + I(lat^2) + I(long^3) + I(bathy^2) + I(bathy^3) + I(dist^2) + I(dist^3) + I(restore^2) + I(restore^3)
y <- log(gravel[, 7] + 1)
glskrigepred1 <- glskrigepred(model = model, longlat = longlat, trainxy = gravel, predx = petrel.grid, y = y, longlatpredx = petrel.grid[, c(1:2)]),
```
transformation = "none", formula.krige = res1 ~ 1,
vgm.args = "Sph", mmaxkrige = 12, corr.args = corSpher(c(range1, nugget1),
form = ~ lat + long, nugget = T))

names(glskrigepred1)

# Back transform 'glskrigepred$predictions' to generate the final predictions
glskrige.predictions <- exp(glskrigepred1$predictions) - 1
range(glskrige.predictions)

---

glspred

Generate spatial predictions using generalized least squares ('gls')

Description

This function is for generating spatial predictions using 'gls' method in 'nlme' package.

Usage

glspred(
  model = var1 ~ 1,
  trainxy,
  longlatpredx,
  predx,
  corr.args = NULL,
  weights = NULL,
  ...
)

Arguments

model a formula defining the response variable and predictive variables.
trainxy a dataframe contains longitude (long), latitude (lat), predictive variables and the
response variable of point samples. That is, the location information must be
names as 'long' and 'lat'.
longlatpredx a dataframe contains longitude and latitude of point locations (i.e., the centers
of grids) to be predicted, need to be named as 'long' and 'lat'.
predx a dataframe or matrix contains columns of predictive variables for the grids to
be predicted.
corr.args arguments for 'correlation' in 'gls'. See '?corClasses' in 'nlme' for details. By
default, "NULL" is used. When "NULL" is used, then 'gls' is actually performing 'lm'.
weights describing the within-group heteroscedasticity structure. Defaults to "NULL",
corresponding to homoscedastic errors. See '?gls' in 'nlme' for details.
... other arguments passed on to 'gls'.

---
**Value**

A dataframe of longitude, latitude and predictions.

**Author(s)**

Jin Li

**References**


**Examples**

```r
library(spm)
library(nlme)

data(petrel)
data(petrel.grid)

gravel <- petrel[, c(1, 2, 6:9, 5)]
range1 <- 0.8
nugget1 <- 0.5
model <- log(gravel + 1) ~ long + lat + bathy + dist + I(long^2) + I(lat^2) + I(lat^3) + I(bathy^2) + I(bathy^3) + I(dist^2) + I(dist^3) + I(relief^2) + I(relief^3)

glspred1 <- glspred(model = model, trainxy = gravel, longlatpredx = petrel.grid[, c(1:2)], predx = petrel.grid, corr.args = corSpher(c(range1, nugget1), form = ~ lat + long, nugget = T))

names(glspred1)

# Back transform 'glspred1$predictions' to generate the final predictions
gls.predictions <- exp(glspred1$predictions) - 1
range(gls.predictions)
```

---

**Description**

This function is a cross validation function for kriging methods (‘krige’) in ‘gstat’.
Usage

```r
krigecv(
  longlat,
  trainy,
  trainpredx = NULL,
  validation = "CV",
  cv.fold = 10,
  nmax = 12,
  transformation = "none",
  delta = 1,
  formula = var1 ~ 1,
  vgm.args = c("Sph"),
  anis = c(0, 1),
  alpha = 0,
  block = 0,
  beta,
  predacc = "VEcv",
  ...)
```

Arguments

- **longlat**: a dataframe contains longitude and latitude of point samples.
- **trainy**: a vector of response, must have length equal to the number of rows in trainx.
- **trainpredx**: a dataframe contains predictive variables of point samples. If longitude and latitude are going to be used as predictive variables, they should also be included but they should be named in names other than ‘long’ and ‘lat’.
- **validation**: validation methods, include ‘LOO’: leave-one-out, and ‘CV’: cross-validation.
- **cv.fold**: integer; number of folds in the cross-validation. if > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.
- **nmax**: for local kriging: the number of nearest observations that should be used for a kriging prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.
- **transformation**: transform response variable to normalise the data; can be "sqrt" for square root, "arcsine" for arcsine, "log" or "none" for non transformation. By default, "none" is used.
- **delta**: numeric; to avoid ‘log(0)’ in "log" transformation. The default is 1.
- **formula**: formula defining response vector and (possible) regressor. an object (i.e., ‘variogram.formula’) for ‘variogram’ or a formula for ‘krige’. see ‘variogram’ and ‘krige’ in the ‘gstat’ package for details.
- **vgm.args**: arguments for ‘vgm’, e.g. variogram model of response variable and anisotropy parameters. see ‘vgm’ in the ‘gstat’ package for details. By default, “Sph” is used.
- **anis**: anisotropy parameters: see notes ‘vgm’ in the ‘gstat’ package for details.
- **alpha**: direction in plane (x,y). see variogram in the ‘gstat’ package for details.
block size. see 'krige' in the 'gstat' package for details.

beta for simple kriging. see 'krige' in the 'gstat' package for details.

predacc can be either "VEcv" for vecv or "ALL" for all measures in function pred.acc.

other arguments passed on to the function 'gstat'.

Value

A list with the following components: me, rme, mae, mae, mse, rmse, rrmse, vecv and e1; or vecv only

Note

This function is largely based on rfcv in 'randomForest' and some functions in 'library(gstat)'. When 'A zero or negative range was fitted to variogram' occurs, to allow 'gstat' running, the range was set to be positive by using 'min(vgm1$dist)'. In this case, caution should be taken in applying this method. If it still occurs for 'okpred' function, different method may need to be used.

Author(s)

Jin Li

References


Examples

```r
library(sp)
library(spm)
data(swmud)
data(petrel)

set.seed(1234) okcv1 <- krigecv(longlat = swmud[, c(1,2)], trainy = swmud[, 3], nmax = 7, transformation = "arcsine", vgm.args = ("Sph"), predacc = "VEcv") okcv1

set.seed(1234) skcv1 <- krigecv(longlat = swmud[, c(1,2)], trainy = swmud[, 3], nmax = 7, transformation = "arcsine", vgm.args = ("Sph"), predacc = "VEcv", beta = mean(swmud[, 3]))
```
skcv1

set.seed(1234)
ukcv1 <- krigecv(longlat = swmud[, c(1,2)], trainy = swmud[, 3], nmax = 7, transformation = "arcsine", formula = var1 ~ long + lat, vgm.args = ("Sph"), predacc = "VEcv")
ukcv1

set.seed(1234)
okcv2 <- krigecv(longlat = swmud[, c(1,2)], trainy = swmud[, 3], validation = "LOO", nmax = 7, transformation = "arcsine", vgm.args = ("Sph"), predacc = "ALL")
okcv2

set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
  okcv1 <- krigecv(longlat = petrel[, c(1,2)], trainy = petrel[, 5], nmax = 12, transformation = "arcsine", predacc = "VEcv")
  VEcv[i] <- okcv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for OK", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) ~ c(1:n), col = 2)
abline(h = mean(VEcv), col = "blue", lwd = 2)

set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
measures <- NULL
for (i in 1:n) {
  okcv1 <- krigecv(longlat = petrel[, c(1,2)], trainy = petrel[, 3], nmax = 12, transformation = "arcsine", predacc = "ALL")
  measures <- rbind(measures, okcv1$vecv)
}
plot(measures ~ c(1:n), xlab = "Iteration for OK", ylab = "VEcv (%)")
points(cumsum(measures) / c(1:n) ~ c(1:n), col = 2)
abline(h = mean(measures), col = "blue", lwd = 2)

---

**krigepred**  
*Generate spatial predictions using kriging methods ('krige')*

**Description**

This function is to make spatial predictions using kriging methods ('krige').

**Usage**

```r
describe
  krigepred(
    trainx,
    trainy,
  )
```
trainx2,
nmax = 12,
transformation = "none",
delta = 1,
formula = var1 ~ 1,
vgm.args = ("Sph"),
anis = c(0, 1),
alpha = 0,
block = 0,
beta, ...
)

Arguments

**trainx**

a dataframe contains longitude (long), latitude (lat) and predictive variables of point samples. The location information must be named as 'long' and 'lat'.

**trainy**

a vector of response, must have length equal to the number of rows in trainx.

**trainx2**

a dataframe contains longitude (long), latitude (lat) and predictive variables of point locations (i.e., the centres of grids) to be predicted. The location information must be named as 'long' and 'lat' and in the first two columns respectively.

**nmax**

for local kriging: the number of nearest observations that should be used for a kriging prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

**transformation**

transform the response variable to normalise the data; can be "sqrt" for square root, "arcsine" for arcsine, "log" or "none" for non transformation. By default, "none" is used.

**delta**

numeric; to avoid log(0) in the log transformation.

**formula**

formula defining the response vector and (possible) regressor. an object (i.e., 'variogram.formula') for 'variogram' or a formula for 'krige'. see 'variogram' and 'krige' in gstat for details.

**vgm.args**

arguments for vgm, e.g. variogram model of response variable and anisotropy parameters. see notes vgm in gstat for details. By default, "Sph" is used.

**anis**

anisotropy parameters: see notes vgm in gstat for details.

**alpha**

direction in plane (x,y). see variogram in gstat for details.

**block**

block size. see krige in gstat for details.

**beta**

for simple kriging. see krige in gstat for details.

**...**

other arguments passed on to gstat.

Value

A dataframe of longitude, latitude, predictions and variances.
The variances in the output are not transformed back when a transformation is used. This is because kriging variances are not measuring the uncertainty of predictions but they are indicator of the spatial distribution of sample density. The variances are exported only for interested users; and if needed, they can be transformed back from the output.

Author(s)

Jin Li

References


Examples

library(sp)
library(spm)
data(swmud)
data(sw)
okpred1 <- krigepred(swmud[, c(1,2)], swmud[, 3], sw, nmax = 7, transformation = "arcsine", vgm.arg = ("Sph"))
names(okpred1)

rfkrigeidwcv
cross validation, n-fold and leave-one-out for the hybrid methods of 'random forest' ('RF'), 'kriging' and inverse distance weighted ('IDW')

Description

This function is a cross validation function for 38 hybrid methods of 'RF', 'kriging' and 'IDW', including the average of 'rfkrige' and 'rfidw' ('rfkrigerfidw') and the average of 'rf', 'rfkrige' and 'rfidw' ('rfrfkrigerfidw'), where 'kriging' methods include ordinary kriging ('OK'), simple kriging ('SK'), block 'OK' ('BOK') and block 'SK'(BSK') and 'IDW' also covers 'NN' and 'KNN'.. The data splitting is based on a stratified random sampling method (see the 'datasplit' function for details).

Usage

rfkrigeidwcv(
  longlat,
  trainx,
  trainy,
mtry = function(p) max(1, floor(sqrt(p))),
ntree = 500,
transformation = "none",
delta = 1,
formula = res1 ~ 1,
vgm.args = c("Sph"),
onis = c(0, 1),
aleta = 0,
blocck = 0,
beta,
nmaxkrige = 12,
idep = 2,
nmaxidw = 12,
hybrid.parameter = 2,
lambda = 1,
validation = "CV",
cv.fold = 10,
preadc = "VEcv",
...)

Arguments

longlat a dataframe contains longitude and latitude of point samples.
trainx a dataframe or matrix contains columns of predictive variables.
trainy a vector of the response variable.
mtry a function of number of remaining predictor variables to use as the 'mtry' pa-
rameter in the 'randomForest' call.
ntree number of trees to grow. This should not be set to too small a number, to ensure
that every input row gets predicted at least a few times. By default, 500 is used.
transformation transform the residuals of 'rf' to normalize the data for 'krige'; can be "sqrt" for
square root, "arcsine" for arcsine, "log" or "none" for non transformation. By
default, "none" is used.
delta numeric; to avoid log(0) in the log transformation. The default is 1.
formula formula defining the response vector and (possible) regressor. an object (i.e.,
'variogram.formula') for 'variogram' or a formula for 'krige'. see 'variogram'
and 'krige' in 'gstat' for details.
vgm.args arguments for 'vgm', e.g. variogram model of response variable and anisotropy
parameters, see 'vgm' in 'gstat' for details. By default, "Sph" is used.
anis anisotropy parameters: see notes 'vgm' in 'gstat' for details.
aleta direction in plane (x,y). see variogram in 'gstat' for details.
block block size. see 'krige' in 'gstat' for details.
beta for simple kriging. see 'krige' in 'gstat' for details.
nmaxkrige for a local predicting: the number of nearest observations that should be used
for a prediction or simulation, where nearest is defined in terms of the space of
the spatial locations. By default, 12 observations are used.
idp a numeric number specifying the inverse distance weighting power.

nmaxidw for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

hybrid.parameter the default is 2 that is for 'rfkrigerfidw'; for 'rfrfkrigerfidw', it needs to be 3.

lambda, ranging from 0 to 2; the default is 1 for 'rfk rigerfidw' and 'rfrfkrigerfidw'; and if it is < 1, more weight is placed on 'krige', otherwise more weight is placed on 'idw'; and if it is 0, 'idw' is not considered and the resultant methods is 'rfk rige' when the default 'hybrid.parameter' is used; and if it is 2, then the resultant method is 'rfidw' when the default 'hybrid.parameter' is used.

validation validation methods, include 'LOO': leave-one-out, and 'CV': cross-validation.

cv.fold integer; number of folds in the cross-validation. if > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.

predacc can be either "VEcv" for vecv or "ALL" for all measures in function pred.acc.

... other arguments passed on to 'randomForest', 'krige' and 'gstat'.

Value
A list with the following components: me, rme, mae, rmae, mse, rmse, vecv and e1; or vecv only

Note
This function is largely based on 'rfcv' in 'randomForest', and 'krigecv' in 'spm2'.

Author(s)
Jin Li

References


Examples

```r
library(spm)
# rfrfokrfidw
data(sponge)
longlat <- sponge[, 1:2]
set.seed(1234)
rfrfkrigerfidwcv1 <- rfkrigeidwcv(longlat = longlat,
trainx = sponge[, -3], trainy = sponge[, 3], formula = res1 ~ 1, vgm.args = ("Sph"),
nmaxkrige = 12, idp = 2, nmaxidw = 12, hybrid.parameter = 3, validation = "CV",
predacc = "ALL")
rfrfkrigerfidwcv1

# rfokrfidw for count data
data(sponge)
longlat <- sponge2[, 1:2]
y = sponge[, 3]
trainx = sponge[, -3]
set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
rfrfkrigerfidwcv1 <- rfkrigeidwcv(longlat = longlat,
trainx = trainx, trainy = y, formula = res1 ~ 1, vgm.args = ("Sph"),
nmaxkrige = 12, idp = 2, nmaxidw = 12, validation = "CV", predacc = "VEcv")
VEcv[i] <- rffrfkrigerfidwcv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for rfokrfidw", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) ~ c(1:n), col = 2)
abline(h = mean(VEcv), col = "blue", lwd = 2)
```

rfkrigeidwpred

Generate spatial predictions using the hybrid methods of 'random forest' ('RF'), 'kriging' and inverse distance weighted ('IDW').

Description

This function is for generating spatial predictions using the hybrid methods of 'RF', 'kriging' and 'IDW', including all methods implemented in 'rfkrigeidwcv'.

Usage

```r
rfkrigeidwpred(
  longlat,
  trainx,
  predx,
  trainy,
```

longlatpredx,
mtry = function(p) max(1, floor(sqrt(p)));
ntree = 500,
transformation = "none",
delta = 1,
formula.krige = res1 ~ 1,
vgm.args = c("Sph"),
anis = c(0, 1),
alpha = 0,
block = 0,
beta,
nmaxkrige = 12,
idp = 2,
nmaxidw = 12,
hybrid.parameter = 2,
lambda = 1,
...
)

Arguments

longlat a dataframe contains longitude and latitude of point samples.
trainx a dataframe contains longitude (long), latitude (lat), predictive variables and the
response variable of point samples. That is, the location information must be
named as 'long' and 'lat'.
predx a dataframe or matrix contains columns of predictive variables for the grids to
be predicted.
trainy a vector of the response variable in the formula, that is, the left part of the for-
formula.
longlatpredx a dataframe contains longitude and latitude of point locations (i.e., the centers
of grids) to be predicted.
mtry a function of number of remaining predictor variables to use as the 'mtry' pa-
rameter in the 'randomForest' call.
ntree number of trees to grow. This should not be set to too small a number, to ensure
that every input row gets predicted at least a few times. By default, 500 is used.
transformation transform the residuals of 'rf' to normalise the data; can be "sqrt" for square
root, "arcsine" for arcsine, "log" or "none" for non transformation. By default,
"none" is used.
delta numeric; to avoid log(0) in the log transformation. The default is 1.
formula.krige formula defining the response vector and (possible) regressor. an object (i.e.,
'variogram.formula') for 'variogram' or a formula for 'krige'. see 'variogram'
and 'krige' in 'gstat' for details.
vgm.args arguments for 'vgm', e.g. variogram model of response variable and anisotropy parameters. see 'vgm' in 'gstat' for details. By default, "Sph" is used.

anis anisotropy parameters: see notes 'vgm' in 'gstat' for details.

alpha direction in plane (x,y). see variogram in 'gstat' for details.

block block size. see 'krige' in 'gstat' for details.

beta for simple kriging. see 'krige' in 'gstat' for details.

nmaxkrige for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

idp a numeric number specifying the inverse distance weighting power.

nmaxidw for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

hybrid.parameter the default is 2 that is for 'rfkrigerfidw'; for 'rfrfkrigerfidw', it needs to be 3.

lambda, ranging from 0 to 2; the default is 1 for 'rfkrigerfidw' and 'rfrfkrigerfidw'; and if it is < 1, more weight is placed on 'krige', otherwise more weight is placed on 'idw'; and if it is 0, 'idw' is not considered and the resultant methods is 'rfkrige' when the default 'hybrid.parameter' is used; and if it is 2, then the resultant method is 'rfidw' when the default 'hybrid.parameter' is used.

... other arguments passed on to 'rf', 'krige' and 'gstat'.

Value

A dataframe of longitude, latitude, and predictions.

Author(s)

Jin Li

References


Examples

```r
library(spm)

data(sponge)
data(sponge.grid)
longlat <- sponge[, 1:2]
y = sponge[, 3]
trainx = sponge[, -3]

set.seed(1234)

rfkrigeidwpred1 <- rfkrigeidwpred(longlat = longlat, trainx = trainx,
predx = sponge.grid, trainy = y, longlatpredx = sponge.grid[, c(1:2)],
formula.krige = res1 ~ 1, vgm.args = "Sph", nmaxkrige = 12, idp = 2, nmaxidw = 12)

names(rfkrigeidwpred1)

range(rfkrigeidwpred1$predictions)
```

---

**sponge2**  
*A dataset of sponge species richness in the Timor Sea region, northern Australia marine margin*

**Description**

This dataset contains 77 samples of 81 variables including easting (longitude), northing (latitude), bathy, backscatter and their derived variables.

**Usage**

```r
data("sponge2")
```

**Format**

A data frame with 77 observations on the following 89 variables.

- **easting** a numeric vector, m
- **northing** a numeric vector, m
- **species.richness** a numeric vector, no unit
- **mud** a numeric vector, percentage
- **sand** a numeric vector, percentage
- **gravel** a numeric vector, percentage
- **bathy** a numeric vector, m
bs25  a numeric vector, dB
bs10  a numeric vector, dB
bs11  a numeric vector, dB
bs12  a numeric vector, dB
bs13  a numeric vector, dB
bs14  a numeric vector, dB
bs15  a numeric vector, dB
bs16  a numeric vector, dB
bs17  a numeric vector, dB
bs18  a numeric vector, dB
bs19  a numeric vector, dB
bs20  a numeric vector, dB
bs21  a numeric vector, dB
bs22  a numeric vector, dB
bs23  a numeric vector, dB
bs24  a numeric vector, dB
bs26  a numeric vector, dB
bs27  a numeric vector, dB
bs28  a numeric vector, dB
bs29  a numeric vector, dB
bs30  a numeric vector, dB
bs31  a numeric vector, dB
bs32  a numeric vector, dB
bs33  a numeric vector, dB
bs34  a numeric vector, dB
bs35  a numeric vector, dB
bs36  a numeric vector, dB
bs_o  a numeric vector, dB
bs_homo_o a numeric vector
bs_entro_o a numeric vector, no unit
bs_var_o a numeric vector, dB^2
bs_lmi_o a numeric vector
bathy_o a numeric vector, m
bathy_lmi_o a numeric vector
tpi_o a numeric vector, no unit
slope_o a numeric vector
plan_cur_o a numeric vector
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<thead>
<tr>
<th>Variable</th>
<th>Type Information</th>
</tr>
</thead>
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<tr>
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</tr>
<tr>
<td>rugosity_o</td>
<td>numeric vector</td>
</tr>
<tr>
<td>dist_coast</td>
<td>numeric vector, m</td>
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<tr>
<td>rugosity7</td>
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<tr>
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</tr>
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<td>numeric vector</td>
</tr>
<tr>
<td>bs_lmi7</td>
<td>numeric vector</td>
</tr>
</tbody>
</table>
Details

For details, please see the source. This dataset was published as an appendix of the paper listed in the source. Where the long and lat were reprojected to easting and northing.

Source

see Appendix A-D. Supplementary data at: "http://dx.doi.org/10.1016/j.envsoft.2017.07.016."

References


spongelonglat A dataset of sponge species richness in the Timor Sea region, northern Australia marine margin

Description

This dataset contains 77 samples of 7 predictive variables including longitude, latitude, bathy, backscatter and their derived variables. It is the sponge dataset in ‘spm’ package, but with long and lat instead of easting and northing.

Usage

data("spongelonglat")

Format

A data frame with 77 observations on the following 8 variables.

sponge a numeric vector
tpi3 a numeric vector
var7 a numeric vector
entro7 a numeric vector
bs34 a numeric vector
bs11 a numeric vector
long a numeric vector
lat a numeric vector

Details

For details, please see sponge dataset in library(spm). Where the long and lat were projected to easting and northing.
Source

sponge dataset in library(spm)

References


Examples

data(spongelonglat)
## maybe str(spongelonglat) ; plot(spongelonglat) ...

---

table(svmcv)

<table>
<thead>
<tr>
<th>svmcv</th>
</tr>
</thead>
<tbody>
<tr>
<td>Cross validation, n-fold and leave-one-out for support vector machine ('svm')</td>
</tr>
</tbody>
</table>

Description

This function is a cross validation function for 'svm' regression in 'e1071' package.

Usage

```r
svmcv(
  formula = NULL,
  trainxy, 
  y,
  scale = TRUE,
  type = NULL,
  kernel = "radial",
  degree = 3,
  gamma = if (is.vector(trainxy)) 1 else 1/ncol(trainxy),
  coef0 = 0,
  cost = 1,
  nu = 0.5,
  tolerance = 0.001,
  epsilon = 0.1,
  validation = "CV",
  cv.fold = 10,
  predacc = "VEcv",
  ...
)
```
Arguments

- **formula**: A formula defining the response variable and predictive variables.
- **trainxy**: A dataframe contains predictive variables and the response variable of point samples. The location information, longitude (long), latitude (lat), need to be included in the 'trainx' for spatial predictive modelling, need to be named as 'long' and 'lat'.
- **y**: A vector of the response variable in the formula, that is, the left part of the formula.
- **scale**: A logical vector indicating the variables to be scaled (default: TRUE).
- **type**: The default setting is 'NULL'. See '?svm' for various options.
- **kernel**: The default setting is 'radial'. See '?svm' for other options.
- **degree**: A parameter needed for kernel of type polynomial (default: 3).
- **gamma**: A parameter needed for all 'kernels' except 'linear' (default: 1/(data dimension)).
- **coef0**: A parameter needed for kernels of type 'polynomial' and 'sigmoid' (default: 0).
- **cost**: Cost of constraints violation (default: 1).
- **nu**: A parameter needed for 'nu-classification', 'nu-regression', and 'one-classification' (default: 0.5).
- **tolerance**: Tolerance of termination criterion (default: 0.001).
- **epsilon**: 'epsilon' in the insensitive-loss function (default: 0.1).
- **validation**: Validation methods, include 'LOO': leave-one-out, and 'CV': cross-validation.
- **cv.fold**: Integer; number of folds in the cross-validation. If > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.
- **predacc**: Can be either "VECv" for 'vecv' or "ALL" for all measures in function pred.acc.
- **...**: Other arguments passed on to 'svm'.

Value

A list with the following components: me, rme, mae, mse, mae, rmse, rrmse, vecv and e1; or vecv only

Note

This function is largely based on 'rfcv' in 'randomForest' and 'svm' in 'e1071'.

Author(s)

Jin Li

References

Examples

```r
library(spm)

data(petrel)
gravel <- petrel[, c(1, 2, 6:9, 5)]
model <- log(gravel + 1) ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)
set.seed(1234)
svmcv1 <- svmcv(formula = model, gravel, log(gravel[, 7] + 1), validation = "CV",
predacc = "ALL")
svmcv1

data(sponge2)
model <- species.richness ~ .
set.seed(1234)
svmcv1 <- svmcv(formula = model, sponge2[, -4], sponge[, 3], gamma = 0.01, cost = 3.5,
scale = TRUE, validation = "CV", predacc = "VEcv")
svmcv1

# For svm
model <- species.richness ~ .
set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
  svmcv1 <- svmcv(formula = model, sponge2[, -4], sponge[, 3], gamma = 0.01, cost = 3.5,
scale = TRUE, validation = "CV", predacc = "VEcv")
  VEcv [i] <- svmcv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for svm", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) ~ c(1:n), col = 2)
abline(h = mean(VEcv), col = 'blue', lwd = 2)
```

svmidwcv

Cross validation, n-fold and leave-one-out for the hybrid method of support vector machine ('svm') regression and inverse distance weighted ('IDW') (svmidw)

Description

This function is a cross validation function for the hybrid method of `svm` regression and `idw` using `gstat` (svmidw), where the data splitting is based on a stratified random sampling method (see the `datasplit` function for details).

Usage

```
svmidwcv(
```
formula = NULL,
longlat,
trainxy,
y,
scale = TRUE,
type = NULL,
kernel = "radial",
degree = 3,
gamma = if (is.vector(trainxy)) 1 else 1/ncol(trainxy),
coef0 = 0,
cost = 1,
u = 0.5,
tolerance = 0.001,
epsilon = 0.1,
idp = 2,
nmaxidw = 12,
validation = "CV",
cv.fold = 10,
predacc = "VEcv",
...

Arguments

formula a formula defining the response variable and predictive variables for 'svm'.
longlat a dataframe contains longitude and latitude of point samples.
trainxy a dataframe contains longitude (long), latitude (lat), predictive variables and the
response variable of point samples. That is, the location information must be
named as 'long' and 'lat'.
y a vector of the response variable in the formula, that is, the left part of the for-
formula.
scale A logical vector indicating the variables to be scaled (default: TRUE).
type the default setting is 'NULL'. See '?svm' for various options.
kernel the default setting is 'radial'. See '?svm' for other options.
degree a parameter needed for kernel of type polynomial (default: 3).
gamma a parameter needed for all 'kernels' except 'linear' (default: 1/(data dimension)).
coef0 a parameter needed for kernels of type 'polynomial' and 'sigmoid' (default: 0).
cost cost of constraints violation (default: 1).
u a parameter needed for 'nu-classification', 'nu-regression', and 'one-classification'
(default: 0.5).
tolerance tolerance of termination criterion (default: 0.001).
epsilon 'epsilon' in the insensitive-loss function (default: 0.1).
idp a numeric number specifying the inverse distance weighting power.
nmaxidw for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

validation methods, include 'LOO': leave-one-out, and 'CV': cross-validation.

cv.fold integer; number of folds in the cross-validation. if > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.

predacc can be either "VEcv" for 'vecv' or "ALL" for all measures in function pred.acc. other arguments passed on to 'svm' and 'gstat'.

Value

A list with the following components: me, rme, mae, rmae, mse, rmse, rrmse, vecv and e1; or vecv only.

Note

This function is largely based on 'rfcv' in 'randomForest', 'idwcv' in 'spm' and 'svm' in 'e1071'.

Author(s)

Jin Li

References


Examples

```r
library(spm)
data(petrel)
gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
model <- log(gravel + 1) ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)
y <- log(gravel[, 7] + 1)
set.seed(1234)
```
svmidwcv1 <- svmidwcv(formula = model, longlat = longlat, trainxy = gravel, y = y, idp = 2, nmaxidw = 12, validation = "CV", predacc = "ALL")

# svmidw for count data
data(sponge2)
model <- species.richness ~ . # use all predictive variables in the dataset
longlat <- sponge2[, 1:2]
set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
  svmidwcv1 <- svmidwcv(formula = model, longlat = longlat, trainxy = sponge2[, -4], y = sponge[, 3], gamma = 0.01, cost = 3.5, scale = TRUE, idp = 2, nmaxidw = 12, validation = "CV", predacc = "VEcv")
  VEcvcv[1] <- svmidwcv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for svmidw", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) ~ c(1:n), col = 2)
abline(h = mean(VEcv), col = "blue", lwd = 2)

svmidwpred

Generate spatial predictions using the hybrid method of Support Vector Machine ('svm') regression and inverse distance weighted (IDW) ('svmidw')

Description

This function is for generating spatial predictions using the hybrid method of 'svm' and 'idw' ('svmidw').

Usage

svmidwpred(
  formula = NULL,
  longlat,
  trainxy,
  y,
  longlatpredx,
  predx,
  scale = TRUE,
  type = NULL,
  kernel = "radial",
  degree = 3,
  gamma = if (is.vector(trainxy)) 1 else 1/ncol(trainxy),
  coef0 = 0,
  cost = 1,
nu = 0.5,
tolerance = 0.001,
epsilon = 0.1,
idp = 2,
nmaxidw = 12,
...)

Arguments

formula a formula defining the response variable and predictive variables for 'svm'.
longlat a dataframe contains longitude and latitude of point samples. The location information must be named as 'long' and 'lat'.
trainxy a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples.
y a vector of the response variable in the formula, that is, the left part of the formula.
longlatpredx a dataframe contains longitude and latitude of point locations (i.e., the centers of grids) to be predicted.
predx a dataframe or matrix contains columns of predictive variables for the grids to be predicted.
scale A logical vector indicating the variables to be scaled (default: TRUE).
type the default setting is 'NULL'. See '?svm' for various options.
kernel the default setting is 'radial'. See '?svm' for other options.
degree a parameter needed for kernel of type polynomial (default: 3).
gamma a parameter needed for all 'kernels' except 'linear' (default: 1/(data dimension)).
coef0 a parameter needed for kernels of type 'polynomial' and 'sigmoid' (default: 0).
cost cost of constraints violation (default: 1).
u a parameter needed for 'nu-classification', 'nu-regression', and 'one-classification' (default: 0.5).
tolerance tolerance of termination criterion (default: 0.001).
epsilon 'epsilon' in the insensitive-loss function (default: 0.1). See '?svm' for details.
idp a numeric number specifying the inverse distance weighting power.
nmaxidw for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.
...
other arguments passed on to 'svm'.

Value

A dataframe of longitude, latitude, and predictions.

Author(s)

Jin Li
References


Examples

library(spm)
data(petrel)
data(petrel.grid)

gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
model <- log(gravel + 1) ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)
y <- log(gravel[, 7] + 1)

svmidwpred1 <- svmidwpred(formula = model, longlat = longlat, trainxy = gravel, y = y, longlatpredx = petrel.grid[, c(1:2)], predx = petrel.grid, idp = 2, nmaxidw = 12)
names(svmidwpred1)

# Back transform 'svmidwpred$predictions' to generate the final predictions
svmidw.predictions <- exp(svmidwpred1$predictions) - 1
range(svmidw.predictions)

svmkrigecv

Cross validation, n-fold and leave-one-out for the hybrid method of support vector machine ('svm') regression and 'krige' (svmkrige)

Description

This function is a cross validation function for the hybrid method of 'svm' regression and 'krige' (svmkrige), where the data splitting is based on a stratified random sampling method (see the 'datasplit' function for details).
Usage

```r
svmkrigecv(
    formula.svm = NULL,
    longlat,
    trainxy,
    y,
    scale = TRUE,
    type = NULL,
    kernel = "radial",
    degree = 3,
    gamma = if (is.vector(trainxy)) 1 else 1/ncol(trainxy),
    coef0 = 0,
    cost = 1,
    nu = 0.5,
    tolerance = 0.001,
    epsilon = 0.1,
    transformation = "none",
    delta = 1,
    formula.krige = res1 ~ 1,
    vgm.args = c("Sph"),
    anis = c(0, 1),
    alpha = 0,
    block = 0,
    beta,
    nmaxkrige = 12,
    validation = "CV",
    cv.fold = 10,
    predacc = "VEcv",
    ...
)
```

Arguments

- `formula.svm`: a formula defining the response variable and predictive variables for 'svm'.
- `longlat`: a dataframe contains longitude and latitude of point samples.
- `trainxy`: a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples. That is, the location information must be named as 'long' and 'lat'.
- `y`: a vector of the response variable in the formula.svm, that is, the left part of the formula.svm.
- `scale`: A logical vector indicating the variables to be scaled (default: TRUE).
- `type`: the default setting is 'NULL'. See '?svm' for various options.
- `kernel`: the default setting is 'radial'. See '?svm' for other options.
- `degree`: a parameter needed for kernel of type polynomial (default: 3).
- `gamma`: a parameter needed for all `kernels` except 'linear' (default: 1/(data dimension)).
- `coef0`: a parameter needed for kernels of type 'polynomial' and 'sigmoid' (default: 0).
cost  cost of constraints violation (default: 1).

nu  a parameter needed for 'nu-classification', 'nu-regression', and 'one-classification' (default: 0.5).

tolerance  tolerance of termination criterion (default: 0.001).

epsilon  'epsilon' in the insensitive-loss function (default: 0.1).

transformation  transform the residuals of 'svm' to normalise the data; can be "sqrt" for square root, "arcsine" for arcsine, "log" or "none" for non transformation. By default, "none" is used.

delta  numeric; to avoid log(0) in the log transformation. The default is 1.

formula.krige  formula defining the response vector and (possible) regressor. an object (i.e., 'variogram.formula') for 'variogram' or a formula for 'krige'. see 'variogram' and 'krige' in 'gstat' for details.

vgm$args  arguments for 'vgm', e.g. variogram model of response variable and anisotropy parameters. see 'vgm' in 'gstat' for details. By default, "Sph" is used.

anis  anisotropy parameters: see notes 'vgm' in 'gstat' for details.

alpha  direction in plane (x,y). see variogram in 'gstat' for details.

block  block size. see 'krige' in 'gstat' for details.

beta  for simple kriging. see 'krige' in 'gstat' for details.

nmaxkrige  for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

validation  validation methods, include 'LOO': leave-one-out, and 'CV': cross-validation.

cv.fold  integer; number of folds in the cross-validation. if > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.

predacc  can be either "VEcv" for 'vecv' or "ALL" for all measures in function pred.acc.

... other arguments passed on to 'svm' and 'krige'.

Value

A list with the following components: me, rme, mae, rmae, mse, rmse, rrmse, vecv and e1; or vecv only

Note

This function is largely based on 'rfcv' in 'randomForest', 'krigecv' in 'spm2' and 'svm' in 'e1071'.

Author(s)

Jin Li
References


Examples

library(spm)
data(petrel)
gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
model <- log(gravel + 1) ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)
y <- log(gravel[, 7] +1)
set.seed(1234)
svmkrigecv1 <- svmkrigecv(formula.svm = model, longlat = longlat, trainxy = gravel, y = y, transformation = "none", formula.krige = res1 ~ 1, vgm.args = "Sph", nmaxkrige = 12, validation = "CV", predacc = "ALL")
svmkrigecv1

# svmok for count data
data(sponge2)
model <- species.richness ~ . # use all predictive variables in the dataset
longlat <- sponge2[, 1:2]
set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
  svmkrigecv1 <- svmkrigecv(formula.svm = model, longlat = longlat, trainxy = sponge2[, -4], y = sponge2[, 3], gamma = 0.01, cost = 3.5, scale = TRUE, formula.krige = res1 ~ 1, vgm.args = ("Sph"), nmaxkrige = 12, validation = "CV", predacc = "VEcv")
  VEcvc[1] <- svmkrigecv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for svm", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) ~ c(1:n), col = 2)
abline(h = mean(VEcv), col = 'blue', lwd = 2)
Description

This function is a cross validation function for 38 hybrid methods of 'svm', 'kriging' and 'IDW', including the average of 'svmkrige' and 'svmidw' ('svmkrigesvmidw') and the average of 'svm', 'svmkrige' and 'svmidw' ('svmsvmsvmkrigesvmidw'), where 'kriging' methods include ordinary kriging ('OK'), simple kriging ('SK'), block 'OK' ('BOK') and block 'SK' ('BSK') and 'IDW' also covers 'NN' and 'KNN'. The data splitting is based on a stratified random sampling method (see the 'datasplit' function for details).

Usage

```r
svmkrigeidwcv(
  formula.svm = NULL,
  longlat,
  trainxy,
  y,
  scale = TRUE,
  type = NULL,
  kernel = "radial",
  degree = 3,
  gamma = if (is.vector(trainxy)) 1 else 1/ncol(trainxy),
  coef0 = 0,
  cost = 1,
  nu = 0.5,
  tolerance = 0.001,
  epsilon = 0.1,
  transformation = "none",
  delta = 1,
  formula.krige = res1 ~ 1,
  vgm.args = c("Sph"),
  anis = c(0, 1),
  alpha = 0,
  block = 0,
  beta,
  nmaxkrige = 12,
  idp = 2,
  nmaxidw = 12,
  hybrid.parameter = 2,
  lambda = 1,
  validation = "CV",
  cv.fold = 10,
  predacc = "VEcv",
)```

Arguments

- **formula.svm**: a formula defining the response variable and predictive variables for 'svm'.
- **longlat**: a dataframe contains longitude and latitude of point samples.
- **trainxy**: a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples. That is, the location information must be named as 'long' and 'lat'.
- **y**: a vector of the response variable in the formula, that is, the left part of the formula.
- **scale**: A logical vector indicating the variables to be scaled (default: TRUE).
- **type**: the default setting is 'NULL'. See '?svm' for various options.
- **kernel**: the default setting is 'radial'. See '?svm' for other options.
- **degree**: a parameter needed for kernel of type polynomial (default: 3).
- **gamma**: a parameter needed for all 'kernels' except 'linear' (default: 1/(data dimension)).
- **coef0**: a parameter needed for kernels of type 'polynomial' and 'sigmoid'(default: 0).
- **cost**: cost of constraints violation (default: 1).
- **nu**: a parameter needed for 'nu-classification', 'nu-regression', and 'one-classification' (default: 0.5).
- **tolerance**: tolerance of termination criterion (default: 0.001).
- **epsilon**: 'epsilon' in the insensitive-loss function (default: 0.1).
- **transformation**: transform the residuals of 'svm' to normalise the data for 'krige'; can be "sqrt" for square root, "arcsine" for arcsine, "log" or "none" for non transformation. By default, "none" is used.
- **delta**: numeric; to avoid log(0) in the log transformation. The default is 1.
- **formula.krige**: formula defining the response vector and (possible) regressor. an object (i.e., 'variogram.formula') for 'variogram' or a formula for 'krige'. see 'variogram' and 'krige' in 'gstat' for details.
- **vgm.args**: arguments for 'vgm', e.g. variogram model of response variable and anisotropy parameters. see 'vgm' in 'gstat' for details. By default, 'Sph' is used.
- **anis**: anisotropy parameters: see notes 'vgm' in 'gstat' for details.
- **alpha**: direction in plane (x,y). see variogram in 'gstat' for details.
- **block**: block size. see 'krige' in 'gstat' for details.
- **beta**: for simple kriging. see 'krige' in 'gstat' for details.
- **nmaxkrige**: for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.
- **idp**: a numeric number specifying the inverse distance weighting power.
for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

the default is 2 that is for 'svmkrigesvmidw'; for 'svmsvmkrigesvmidw', it needs to be 3.

ranging from 0 to 2; the default is 1 for 'svmkrigesvmidw' and 'svmsvmkrigesvmidw'; and if it is < 1, more weight is placed on 'krige', otherwise more weight is placed on 'idw'; and if it is 0, 'idw' is not considered and the resultant methods is 'svmkrige' when the default 'hybrid.parameter' is used; and if it is 2, then the resultant method is 'svmidw' when the default 'hybrid.parameter' is used.

validation methods, include 'LOO': leave-one-out, and 'CV': cross-validation.

integer; number of folds in the cross-validation. if > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.

can be either "VEcv" for vecv or "ALL" for all measures in function pred.acc.

other arguments passed on to 'svm', 'krige' and 'gstat'.

A list with the following components: me, rme, mae, rmae, mse, rmse, rrmse, vecv and e1; or vecv only

This function is largely based on 'rfcv' in 'randomForest', 'krigecv' in 'spm' and 'svm' in 'e1071'.

Jin Li


Examples

```r
library(spm)
# svmokglidw
data(petrel)
gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
model <- log(gravel + 1) ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)
y <- log(gravel[, 7] + 1)
set.seed(1234)
svmkrigesvmidwcv1 <- svmkrigeidwcv(formula.svm = model, longlat = longlat,
trainxy = gravel, y = y, transformation = "none", formula.krige = res1 ~ 1,
vgm.args = "Sph", nmaxkrige = 12, idp = 2, nmaxidw = 12, validation = "CV",
predacc = "ALL")
svmkrigesvmidwcv1
```

```r
# svmsvmoksvmidw
data(sponge2)
model <- species.richness ~ . # use all predictive variables in the dataset
longlat <- sponge2[, 1:2]
y = sponge2[, 3]
set.seed(1234)
svmsvmkrigesvmidwcv1 <- svmkrigeidwcv(formula.svm = model, longlat = longlat,
trainxy = sponge2[, -4], y = y, gamma = 0.01, cost = 3.5, scale = TRUE,
formula.krige = res1 ~ 1, vgm.args = "Sph", nmaxkrige = 12, idp = 2,
nmaxidw = 12, hybrid.parameter = 3, validation = "CV", predacc = "ALL")
svmsvmkrigesvmidwcv1
```

```r
# svmoksvmidw for count data
data(sponge2)
model <- species.richness ~ . # use all predictive variables in the dataset
longlat <- sponge2[, 1:2]
y = sponge2[, 3]
set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
  svmkrigesvmidwcv1 <- svmkrigeidwcv(formula.svm = model, longlat = longlat,
trainxy = sponge2[, -4], y = y, gamma = 0.01, cost = 3.5, scale = TRUE,
formula.krige = res1 ~ 1, vgm.args = "Sph", nmaxkrige = 12, idp = 2,
nmaxidw = 12, validation = "CV", predacc = "VEcv")
  VEcv[i] <- svmkrigesvmidwcv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for svm", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) ~ c(1:n), col = 2)
abline(h = mean(VEcv), col = 'blue', lwd = 2)
```
Generate spatial predictions using the hybrid methods of support vector machine ('svm') regression, 'kriging' and inverse distance weighted ('IDW').

Description

This function is for generating spatial predictions using the hybrid methods of 'svm', 'kriging' and 'IDW', including all methods implemented in 'svmkrigeidwcv'.

Usage

```r
svmkrigeidwpred(
  formula.svm = NULL,
  longlat, trainxy, predx, y, longlatpredx, scale = TRUE,
  type = NULL, kernel = "radial", degree = 3,
  gamma = if (is.vector(trainxy)) 1 else 1/ncol(trainxy),
  coef0 = 0, cost = 1, nu = 0.5,
  tolerance = 0.001, epsilon = 0.1,
  transformation = "none", delta = 1,
  formula.krige = res1 ~ 1,
  vgm.args = c("Sph"), anis = c(0, 1),
  alpha = 0, block = 0, beta,
  nmaxkrige = 12, idp = 2,
  nmaxidw = 12, hybrid.parameter = 2,
  lambda = 1,
  ...
)
```

Arguments

- `formula.svm` a formula defining the response variable and predictive variables for 'svm'.

longlat a dataframe contains longitude and latitude of point samples.

trainxy a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples.

predx a dataframe or matrix contains columns of predictive variables for the grids to be predicted.

y a vector of the response variable in the formula, that is, the left part of the formula.

longlatpredx a dataframe contains longitude and latitude of point locations (i.e., the centers of grids) to be predicted.

scale A logical vector indicating the variables to be scaled (default: TRUE).

type the default setting is ‘NULL’. See ‘svm’ for various options.

kernel the default setting is ‘radial’. See ‘svm’ for other options.

degree a parameter needed for kernel of type polynomial (default: 3).

gamma a parameter needed for all ‘kernels’ except ‘linear’ (default: 1/(data dimension)).

coef0 a parameter needed for kernels of type ‘polynomial’ and ‘sigmoid’ (default: 0).

cost cost of constraints violation (default: 1).

nu a parameter needed for ‘nu-classification’, ‘nu-regression’, and ‘one-classification’ (default: 0.5).

tolerance tolerance of termination criterion (default: 0.001).

epsilon ‘epsilon’ in the insensitive-loss function (default: 0.1). See ‘svm’ for details.

transformation transform the residuals of ‘svm’ to normalise the data; can be “sqrt” for square root, “arcsine” for arcsine, “log” or “none” for non transformation. By default, “none” is used.

delta numeric; to avoid log(0) in the log transformation. The default is 1.

formula.krige formula defining the response vector and (possible) regressor. an object (i.e., ‘variogram.formula’) for ‘variogram’ or a formula for ‘krige’. see ‘variogram’ and ‘krige’ in ‘gstat’ for details.

vgm.args arguments for ‘vgm’, e.g. variogram model of response variable and anisotropy parameters. see ‘vgm’ in ‘gstat’ for details. By default, “Sph” is used.

anis anisotropy parameters: see notes ‘vgm’ in ‘gstat’ for details.

alpha direction in plane (x,y). see variogram in ‘gstat’ for details.

block block size. see ‘krige’ in ‘gstat’ for details.

beta for simple kriging. see ‘krige’ in ‘gstat’ for details.

nmaxkrige for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.

idp a numeric number specifying the inverse distance weighting power.

nmaxidw for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.
**Value**

A dataframe of longitude, latitude, and predictions.

**Author(s)**

Jin Li

**References**


**Examples**

```r
library(spm)
data(petrel)
data(petrel.grid)
gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
model <- log(gravel + 1) ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)
y <- log(gravel[, 7] + 1)

svmkrigeidwpred1 <- svmkrigeidwpred(formula.svm = model, longlat = longlat, trainxy = gravel, 
predx = petrel.grid, y = y, longlatpredx = petrel.grid[, c(1:2)], 
formula.krige = res1 ~ 1, vgm.args = "Sph", nmaxkrige = 12, idp = 2, nmaxidw = 12)
```

**svmkrigeidwpred**

- `hybrid.parameter`:
  - The default is 2 that is for 'svmkrigesvmidw'; for 'svmsvmkrigesvmidw', it needs to be 3.
  - `lambda`, ranging from 0 to 2; the default is 1 for 'svmkrigesvmidw' and 'svmsvmkrigesvmidw'; and if it is < 1, more weight is placed on 'krige', otherwise more weight is placed on 'idw'; and if it is 0, 'idw' is not considered and the resultant methods is 'svmkrige' when the default 'hybrid.parameter' is used; and if it is 2, then the resultant method is 'svmidw' when the default 'hybrid.parameter' is used.
  - Other arguments passed on to 'svm', 'krige' and 'gstat'.

- `Value`:
  - A dataframe of longitude, latitude, and predictions.
names(svmkrigeidwpred)

# Back transform 'svmkrigeidwpred$predictions' to generate the final predictions
svmkrigeidw.predictions <- exp(svmkrigeidwpred$predictions) - 1
range(svmkrigeidw.predictions)

---

**svmkrigepred**

*Generate spatial predictions using the hybrid method of support vector machine ('svm') regression and 'krige' (svmkrige)*

**Description**

This function is for generating spatial predictions using the hybrid method of 'svm' and 'krige' (svmkrige).

**Usage**

```r
svmkrigepred(
  formula.svm = NULL,
  longlat,
  trainxy,
  predx,
  y,
  longlatpredx,
  scale = TRUE,
  type = NULL,
  kernel = "radial",
  degree = 3,
  gamma = if (is.vector(trainxy)) 1 else 1/ncol(trainxy),
  coef0 = 0,
  cost = 1,
  nu = 0.5,
  tolerance = 0.001,
  epsilon = 0.1,
  transformation = "none",
  delta = 1,
  formula.krige = res1 ~ 1,
  vgm.args = c("Sph"),
  anis = c(0, 1),
  alpha = 0,
  block = 0,
  beta,
  nmaxkrige = 12,
  ...
)
```

**Arguments**

- `formula.svm` a formula defining the response variable and predictive variables for 'svm'.
- `longlat` a dataframe contains longitude and latitude of point samples.
- `trainxy` a dataframe contains longitude (long), latitude (lat), predictive variables and the response variable of point samples.
- `predx` a dataframe or matrix contains columns of predictive variables for the grids to be predicted.
- `y` a vector of the response variable in the formula, that is, the left part of the formula.
- `longlatpredx` a dataframe contains longitude and latitude of point locations (i.e., the centers of grids) to be predicted.
- `scale` A logical vector indicating the variables to be scaled (default: TRUE).
- `type` the default setting is 'NULL'. See '?svm' for various options.
- `kernel` the default setting is 'radial'. See '?svm' for other options.
- `degree` a parameter needed for kernel of type polynomial (default: 3).
- `gamma` a parameter needed for all 'kernels' except 'linear' (default: 1/(data dimension)).
- `coef0` a parameter needed for kernels of type 'polynomial' and 'sigmoid' (default: 0).
- `cost` cost of constraints violation (default: 1).
- `nu` a parameter needed for 'nu-classification', 'nu-regression', and 'one-classification' (default: 0.5).
- `tolerance` tolerance of termination criterion (default: 0.001).
- `epsilon` 'epsilon' in the insensitive-loss function (default: 0.1). See '?svm' for details.
- `transformation` transform the residuals of 'svm' to normalise the data; can be "sqrt" for square root, "arcsine" for arcsine, "log" or "none" for non transformation. By default, "none" is used.
- `delta` numeric; to avoid log(0) in the log transformation. The default is 1.
- `formula.krige` formula defining the response vector and (possible) regressor. an object (i.e., 'variogram.formula') for 'variogram' or a formula for 'krige'. see 'variogram' and 'krige' in 'gstat' for details.
- `vgm.args` arguments for 'vgm', e.g. variogram model of response variable and anisotropy parameters. see 'vgm' in 'gstat' for details. By default, 'Sph' is used.
- `anis` anisotropy parameters: see notes 'vgm' in 'gstat' for details.
- `alpha` direction in plane (x,y). see variogram in 'gstat' for details.
- `block` block size. see 'krige' in 'gstat' for details.
- `beta` for simple kriging. see 'krige' in 'gstat' for details.
- `nmaxkrige` for a local predicting: the number of nearest observations that should be used for a prediction or simulation, where nearest is defined in terms of the space of the spatial locations. By default, 12 observations are used.
- `...` other arguments passed on to 'svm' and 'krige'.

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Value

A dataframe of longitude, latitude, and predictions.

Author(s)

Jin Li

References


Examples

library(spm)
data(petrel)
data(petrel.grid)
gravel <- petrel[, c(1, 2, 6:9, 5)]
longlat <- petrel[, c(1, 2)]
model <- log(gravel + 1) ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)
y <- log(gravel[, 7] +1)

svmkrigepred1 <- svmkrigepred(formula.svm = model, longlat = longlat, trainxy = gravel, 
predx = petrel.grid, y = y, longlatpredx = petrel.grid[, c(1:2)],
transformation = "none", formula.krige = res1 ~ 1, vgm.args = "Sph", nmaxkrige = 12)

names(svmkrigepred1)

# Back transform 'svmkrigepred$predictions' to generate the final predictions
svmkrige.predictions <- exp(svmkrigepred1$predictions) - 1
range(svmkrige.predictions)
svmpred

Generate spatial predictions using support vector machine ('svm')

Description

This function is for generating spatial predictions using 'svm' method in 'e1071' package.

Usage

svmpred(
  formula = NULL,
  trainxy,
  longlatpredx,
  predx,
  scale = TRUE,
  type = NULL,
  kernel = "radial",
  degree = 3,
  gamma = if (is.vector(trainxy)) 1 else 1/ncol(trainxy),
  coef0 = 0,
  cost = 1,
  nu = 0.5,
  tolerance = 0.001,
  epsilon = 0.1,
  ...
)

Arguments

formula a formula defining the response variable and predictive variables.
trainxy a dataframe contains predictive variables and the response variable of point samples. The location information, longitude (long), latitude (lat), need to be included in the 'trainx' for spatial predictive modeling, need to be named as 'long' and 'lat'.
longlatpredx a dataframe contains longitude and latitude of point locations (i.e., the centers of grids) to be predicted, need to be named as 'long' and 'lat'.
predx a dataframe or matrix contains columns of predictive variables for the grids to be predicted.
scale A logical vector indicating the variables to be scaled (default: TRUE).
type the default setting is 'NULL'. See '?svm' for various options.
kernels the default setting is 'radial'. See '?svm' for other options.
degree a parameter needed for kernel of type polynomial (default: 3).
gamma a parameter needed for all 'kernels' except 'linear' (default: 1/(data dimension)).
coef0 a parameter needed for kernels of type 'polynomial' and 'sigmoid'(default: 0).
cost  cost of constraints violation (default: 1).

nu    a parameter needed for 'nu-classification', 'nu-regression', and 'one-classification' (default: 0.5).

tolerance    tolerance of termination criterion (default: 0.001).

epsilon    'epsilon' in the insensitive-loss function (default: 0.1). See '?svm' for details.

... other arguments passed on to 'svm'.

Value

A dataframe of longitude, latitude and predictions.

Author(s)

Jin Li

References


Examples

library(spm)
data(petrel)
data(petrel.grid)

gravel <- petrel[, c(1, 2, 6:9, 5)]
model <- log(gravel + 1) ~ lat + bathy + I(long^3) + I(lat^2) + I(lat^3)

svmpred1 <- svmpred(formula = model, trainxy = gravel,
                     longlatpredx = petrel.grid[, c(1:2)], predx = petrel.grid)

names(svmpred1)

# Back transform 'svmpred1$pred.svm' to generate the final predictions
svm.predictions <- exp(svmpred1$pred.svm) - 1
range(svm.predictions)
tpscv

Description

This function is a cross validation function for 'Tps' method in 'fields' package.

Usage

tpscv(
    trainx, 
    trainy, 
    m = NULL, 
    p = NULL, 
    theta = 3, 
    lambda = NULL, 
    lon.lat = TRUE, 
    validation = "CV", 
    cv.fold = 10, 
    predacc = "VEcv", 
    ...
)

Arguments

trainx a dataframe contains longitude (long), latitude (lat) and predictive variables of point samples. That is, they must be names as 'long' and 'lat'.

trainy a vector of response, must have length equal to the number of rows in trainx.

m A polynomial function of degree (m-1) will be included in the model as the drift (or spatial trend) component. Default is 'm = NULL' that is the value such that 2m-d is greater than zero where d is the dimension of x.

p polynomial power for Wendland radial basis functions as in 'Tps'. 'p = NULL' that leads to a default value of 2 for spatial predictive modelling based on 'x' containing only the location information.

theta the tapering range. 'theta = 3' degrees is a very generous taper range. For spatial predictive modeling the taper should be large enough to about 20 non zero nearest neighbors for every location.

lambda smoothing parameter, the default is 'NULL'. See '?Tps' for further info.

lon.lat if 'TRUE' locations are interpreted as longitude and latitude and great circle distance is used to find distances among locations.

validation validation methods, include 'LOO': leave-one-out, and 'CV': cross-validation.

cv.fold integer; number of folds in the cross-validation. if > 1, then apply n-fold cross validation; the default is 10, i.e., 10-fold cross validation that is recommended.

predacc can be either "VEcv" for vecv or "ALL" for all measures in function pred.acc.

... other arguments passed on to 'gstat'.
Value

A list with the following components: me, rme, mae, rmae, mse, rmse, rrmse, vecv and e1; or vecv only

Note

This function is largely based on 'krigecv' in this package and 'Tps' and 'fastTpsMLE' in 'fields' package.

Author(s)

Jin Li

References


Examples

```r
library(fields)
library(spm)
data(petrel)

tpscv1 <- tpscv(petrel[, c(1,2)], petrel[, 5], cv.fold = 5, predacc = "VEcv")

set.seed(1234)
n <- 20 # number of iterations, 60 to 100 is recommended.
VEcv <- NULL
for (i in 1:n) {
  tpscv1 <- tpscv(petrel[, c(1,2)], petrel[, 5], cv.fold = 10, lambda = 0.13, predacc = "VEcv")
  VEcv [i] <- tpscv1
}
plot(VEcv ~ c(1:n), xlab = "Iteration for TPS", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) - c(1:n), col = 2)
abline(h = mean(VEcv), col = "blue", lwd = 2)
```

n <- 20 # number of iterations, 60 to 100 is recommended.
# set.seed(1234)
VEcv <- NULL
for (i in 1:n) {
  set.seed(1234 + i) # set random seed for each iteration. You can remove...
# this line and use above set.seed(1234) and see what you can get.

tpscvm <- tpscvm(petrel[, c(1,2)], petrel[, 5], predacc = "VEcv")

VEcv[c] <- tpscvm

plot(VEcv ~ c(1:n), xlab = "Iteration for TPS", ylab = "VEcv (%)")
points(cumsum(VEcv) / c(1:n) ~ c(1:n), col = 2)
abline(h = mean(VEcv), col = 'blue', lwd = 2)
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