Package 'MultivarTV'

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Type Package

Title Mesh Based Solutions to Multivariate Total Variation Problems

Version 1.0

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Author Brayan Ortiz

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Description Efficient procedures written in C++ for fitting approximate solutions to multivariate total variation denoising problems. The algorithm uses the alternating direction method of multipliers (ADMM), as described by Boyd et al. (2011).

License GPL (>= 2)

Imports Rcpp (>= 0.12.16), plot3D

LinkingTo Rcpp, RcppArmadillo

RoxygenNote 6.0.1

Suggests knitr, rmarkdown

VignetteBuilder knitr

NeedsCompilation yes

R topics documented:

MultivarTV-package *Mesh Based Solutions to Multivariate Total Variation Problems*

Description

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Details

The DESCRIPTION file:

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RoxygenNote:	6.0.1
Suggests:	knitr, rmarkdown
VignetteBuilder:	knitr

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                        Solver
mvtv_default            Default Multivariate Total Variation Denoising
                        Solver for use by S3 Generic
plot.mvtv               Plotting Fitted Surface, p=1
plotResiduals           Plotting Residuals
predict.mvtv            MVTV Predict for Fitting Observed/New Data
predict_mvtv            MVTV Predict for use by S3 Generic Function
```

This section should provide a more detailed overview of how to use the package, including the most important functions.

Author(s)

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References

This optional section can contain literature or other references for background information.

See Also

Optional links to other man pages

Examples

```
## Optional simple examples of the most important functions
## Use \dontrun{} around code to be shown but not executed
```

`gen_mesh` *Generate a mesh*

Description

Single function to handle creating a mesh regularly across domain of predictors. Mesh created is a convex hull of predictor space.

Usage

```
gen_mesh(data, m, mesh)
```

Arguments

`data`	n by p matrix of inputs
`m`	vector of length p with number of knots desired for each predictor
`mesh`	NULL; otherwise, takes user defined mesh.

mvtv *MVTV Generic Class*

Description

Defining MVTV Generic Class

Usage

```
mvtv(data, ...)
```

Arguments

data	n by p matrix of data
...	ignore

mvtv.default *Default Multivariate Total Variation Denoising Solver*

Description

Create a mesh and find cross-validated best approximation to total variation denoising problem.

Usage

```
## Default S3 method:
mvtv(data, y, m = NULL, ..., mesh = NULL,
  n_lambda = 100, ftrue = NULL, lambdas = NULL, folds = 5,
  verbose = TRUE)
```

Arguments

data	n by p matrix of inputs
y	response column vector
m	vector of number of mesh points per predictor
...	ignore
mesh	user can supply or NULL for regularly spaced mesh, which will be returned
n_lambda	number of logarithmically spaced tuning parameters
ftrue	prediction target. If NULL, use observed data.
lambdas	user can supply vector of lambdas to be solved over. If NULL, function generates n_lambda logarithmically spaced lambdas from 0.00001*lambda_max and lambda_max, where lambda_max is our approximation of smallest lambda where regularization ends.
folds	number of folds for cross-validation
verbose	Default: true, prints out current working penalty and number of iters to solve.

Examples

```
# Approximating Bivariate Fused Lasso for Uniform Data
## Generate Data
set.seed(117)
x <- matrix(runif(100),ncol = 2)
y <- matrix(runif(50),ncol=1)
m <- matrix(c(3,3),ncol=1)

## Find Total Variation Solution over range of lambdas and whole data set
mvtv_fold1 <- mvtv(x,y,m,folds=1, verbose = FALSE)

## Find 5-fold validated MVTV Model over range of lambdas
mvtv_fold5 <- mvtv(x,y,m,folds=5, verbose = FALSE)
```

`mvtv_default` *Default Multivariate Total Variation Denoising Solver for use by S3 Generic*

Description

Create a mesh and find cross-validated best approximation to total variation denoising problem.

Usage

```
mvtv_default(data, y, m, mesh = NULL, n_lambda = 100L, ftrue = NULL,
  lambdas = NULL, folds = 5L, verbose = TRUE)
```

Arguments

`data`	n by p matrix of inputs
`y`	response column vector
`m`	vector of number of mesh points per predictor
`mesh`	user can supply or NULL for regularly spaced mesh, which will be returned
`n_lambda`	number of logarithmically spaced tuning parameters
`ftrue`	prediction target. If NULL, use observed data.
`lambdas`	user can supply vector of lambdas to be solved over. If NULL, function generates n_lambda logarithmically spaced lambdas from 0.00001*lambda_max and lambda_max, where lambda_max is our approximation of smallest lambda where regularization ends.
`folds`	number of folds for cross-validation
`verbose`	Default: true, prints out current working penalty and number of iters to solve.

plot.mvtv *Plotting Fitted Surface, p=1*

Description

Plotting fitted values for an 'mvtv' Object

Usage

```
## S3 method for class 'mvtv'
plot(x, ..., addmesh = FALSE, adddata = TRUE,
  lambda = NULL)
```

Arguments

x	object of class 'mvtv.'
...	ignore.
addmesh	If TRUE, vertical grey lines plotted along x-axis value of mesh.
adddata	If TRUE, observed data is plotted.
lambda	Plot at specified lambda. If NULL, plot fit at lambda with smalled cross-validated MSE.

plotResiduals *Plotting Residuals*

Description

Plotting residuals for an 'mvtv' Object

Usage

```
plotResiduals(mvtvmodel)
```

Arguments

mvtvmodel	object of class 'mvtv'

predict.mvtv *MVTV Predict for Fitting Observed/New Data*

Description

Use fitted 'mvtv' object to predict new data.

Usage

```
## S3 method for class 'mvtv'
predict(object, data = NULL, mesh = NULL, ...)
```

Arguments

object	object produced by mvtv.default
data	n by p matrix of inputs
mesh	m by p mesh used by fitting function mvtv
...	ignore

Examples

```
# Approximating Bivariate Fused Lasso for Uniform Data
## Generate Data
set.seed(117)
x <- matrix(runif(100),ncol = 2)
y <- matrix(runif(50),ncol=1)
m <- matrix(c(3,3))

## Find 5-fold validated MBS Model over range of lambdas
mbs_fold5 <- mvtv(x,y,m,folds=5,verbose=FALSE)

# Access fitted values of training data; equivalent to mbs_fold5$fitted
fitted.values <- predict(mbs_fold5)
newdata <- matrix( runif(50), ncol = 2) # Generate new data
newfits <- predict(mbs_fold5, newdata) # Fit new data
```

predict_mvtv *MVTV Predict for use by S3 Generic Function*

Description

Use fitted 'mvtv' object to predict new data.

Usage

```
predict_mvtv(mvtvobject, data = NULL, mesh = NULL)
```

Arguments

`mvtvobject`	object produced by mbtv.default
`data`	n by p matrix of inputs
`mesh`	m by p mesh used by fitting function mvtv

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