Package 'MultivarTV'

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Type Package

Title Mesh Based Solutions to Multivariate Total Variation Problems

Version 1.0

Date 2018-04-05

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

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

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).

Details

The DESCRIPTION file:

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Type:	Package
Title:	Mesh Based Solutions to Multivariate Total Variation Problems
Version:	1.0
Date:	2018-04-05
Author:	Brayan Ortiz
Maintainer:	Brayan Ortiz <brayan@uw.edu>
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License:	GPL (>= 2)
Imports:	Rcpp (>= 0.12.16), plot3D
LinkingTo:	Rcpp, RcppArmadillo
RoxygenNote:	6.0.1
Suggests:	knitr, rmarkdown
VignetteBuilder:	knitr

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                        Variation Problems
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mvtv                    MVTV Generic Class
mvtv.default            Default Multivariate Total Variation Denoising
                        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)

Brayan Ortiz

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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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