Package: oscar (via r-universe)

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Type Package

Title Optimal Subset Cardinality Regression (OSCAR) Models Using the L0-Pseudonorm

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Description Optimal Subset Cardinality Regression (OSCAR) models offer regularized linear regression using the L0-pseudonorm, conventionally known as the number of non-zero coefficients. The package estimates an optimal subset of features using the L0-penalization via cross-validation, bootstrapping and visual diagnostics. Effective Fortran implementations are offered along the package for finding optima for the DC-decomposition, which is used for transforming the discrete L0-regularized optimization problem into a continuous non-convex optimization task. These optimization modules include DBDC ('Double Bundle method for nonsmooth DC optimization' as described in Joki et al. (2018) <doi:10.1137/16M1115733>) and LMBM ('Limited Memory Bundle Method for large-scale nonsmooth optimization' as in Haarala et al. (2004) <doi:10.1080/10556780410001689225>). The OSCAR models are comprehensively exemplified in Halkola et al. (2023) <doi:10.1371/journal.pcbi.1010333>). Multiple regression model families are supported: Cox, logistic, and Gaussian.

License GPL-3

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Contents

oscar-package . . . 2
coef,oscar-method . . . 3
cost . . . 4
Example data . . . 4
feat . . . 5
kits . . . 5
oscar . . . 6
oscar-class . . . 8
oscar.binarize . . . 8
oscar.binplot . . . 9
oscar.bs . . . 10
oscar.bs.boxplot . . . 11
oscar.bs.k . . . 11
oscar.bs.plot . . . 12
oscar.bs.visu . . . 13
oscar.control . . . 14
oscar.cost.after . . . 16
oscar.cv . . . 16
oscar.cv.visu . . . 17
oscar.pareto . . . 18
oscar.pareto.visu . . . 19
oscar.sparsify . . . 20
oscar.visu . . . 21
show,oscar-method . . . 22

Index **23**

`oscar-package` *oscar: Optimal Subset Cardinality Regression*

Description

OSCAR models utilize the L0-pseudonorm to select an optimal subset of features that generalizes linear regression models to a variety of families. Currently supported models include conventional Gaussian regression (family="mse" or family="gaussian"), Binomial/Logistic regression (family="logistic"), and Cox proportional hazards modeling (family="cox").

References

Halkola AS, Joki K, Mirtti T, Mäkelä MM, Aittokallio T, Laajala TD (2023) OSCAR: Optimal subset cardinality regression using the L0-pseudonorm with applications to prognostic modelling of prostate cancer. PLoS Comput Biol 19(3): e1010333. doi:10.1371/journal.pcbi.1010333

`coef,oscar-method` *Extract coefficients of oscar-objects*

Description

Extract coefficients of oscar-objects

Prediction based on oscar-objects

Plot oscar-coefficients as a function of k and override default plot generic

Usage

```
## S4 method for signature 'oscar'
coef(object, k)

## S4 method for signature 'oscar'
predict(
  object,
  k,
  type = c("response", "link", "nonzero", "coefficients", "label"),
  newdata = object@x
)

## S4 method for signature 'oscar'
plot(x, y, k = 1:x@kmax, add = FALSE, intercept = FALSE, ...)
```

Arguments

`object`	Fit oscar S4-object
`k`	Vector of cardinality 'k' values
`type`	Type of prediction; valid values are 'response', 'link', 'nonzero', 'coefficients', or 'label'
`newdata`	Data to predict on; if no alternate is supplied, the function uses the original 'x' data matrix used to fit object
`x`	Values on x-axis
`y`	Values on y-axis
`add`	Should the plot be added on top of an existing plot (if FALSE, create a new graphics device), Default: FALSE
`intercept`	Should model intercept be plotted, Default: FALSE
`...`	Additional parameters passed on to the points-function drawing lines as a function of cardinality

Value

Vector of model coefficient values at given cardinality 'k'

A vector of coefficient predictions at the specificied cardinality 'k' with a format depending on the supplied 'type' parameter

Override default plot function with no return but instead tailor suitable graphics plotting

---

`cost` *Return total cost of model fit based on provided kit/variable costs vector*

Description

Return total cost of model fit based on provided kit/variable costs vector

Return total cost of model fit based on provided kit/variable costs vector

Usage

```
cost(object, k)

## S4 method for signature 'oscar'
cost(object, k)
```

Arguments

`object`	Fit oscar S4-object
`k`	Cardinality 'k' to compute total feature cost at

Value

Numeric value of total feature/kit cost at cardinality 'k'

Numeric value of total feature/kit cost at cardinality 'k'

`Example data` *Example data from TYKS / HUSLAB*

Description

An example data set from mCRPC patients in TYKS, along with cost vector / kit structure from HUSLAB

Usage

```
data(ex)
```

Examples

```
data(ex)
```

feat — *Return named vector of feature indices with a given k that are non-zero*

Description

Return named vector of feature indices with a given k that are non-zero

Return named vector of feature indices with a given k that are non-zero

Usage

```
feat(object, k)

## S4 method for signature 'oscar'
feat(object, k)
```

Arguments

object	Fit oscar S4-object
k	Cardinality 'k' to extract non-zero features at

Value

Vector of feature indices at cardinality 'k'

Vector of feature indices at cardinality 'k'

kits — *Return named vector of indices for kits with a given k that are non-zero*

Description

Return named vector of indices for kits with a given k that are non-zero

Return named vector of indices for kits with a given k that are non-zero

Usage

```
kits(object, k)

## S4 method for signature 'oscar'
kits(object, k)
```

Arguments

object	Fit oscar S4-object
k	Cardinality 'k' to extract kit indices at

Value

Vector of kit indices at cardinality 'k'

Vector of kit indices at cardinality 'k'

`oscar` *Main OSCAR fitting function*

Description

This function fits an OSCAR model object to the provided training data with the desired model family.

Usage

```
oscar(
  x,
  y,
  k,
  w,
  family = "cox",
  metric,
  solver = 1,
  verb = 1,
  print = 3,
  kmax,
  sanitize = TRUE,
  percentage = 1,
  in_selection = 1,
  storeX = TRUE,
  storeY = TRUE,
  control,
  ...
)
```

Arguments

`x`	Data matrix 'x'
`y`	Response vector/two-column matrix 'y' (see: family); number of rows equal to nrow(x)
`k`	Integer (0/1) kit indicator matrix; number of columns equal to ncol(x), Default: Unit diagonal indicator matrix
`w`	Kit cost weight vector w of length nrow(k), Default: Equal cost for all variables
`family`	Model family, should be one of: 'cox', 'mse'/'gaussian', or 'logistic, Default: 'cox'

metric	Goodness metric, Default(s): Concordance index for Cox, MSE for Gaussian, and AUC for logistic regression
solver	Solver used in the optimization, should be 1/'DBDC' or 2/'LMBM', Default: 1.
verb	Level of verbosity in R, Default: 1
print	Level of verbosity in Fortran (may not be visible on all terminals); should be an integer between range, range, Default: 3
kmax	Maximum k step tested, by default all k are tested from k to maximum dimensionality, Default: ncol(x)
sanitize	Whether input column names should be cleaned of potentially problematic symbols, Default: TRUE
percentage	Percentage of possible starting points used within range [0,1], Default: 1
in_selection	Which starting point selection strategy is used (1, 2 or 3), Default: 1
storeX	If data matrix X should be saved in the model object; turning this off might would help with memory, Default: TRUE
storeY	If data response Y should be saved in the model object; turning this off might would help with memory, Default: TRUE
control	Tuning parameters for the optimizers, see function oscar.control(), Default: see ?oscar.control
...	Additional parameters

Details

OSCAR utilizes the L0-pseudonorm, also known as the best subset selection, and makes use of a DC-formulation of the discrete feature selection task into a continuous one. Then an appropriate optimization algorithm is utilized to find optima at different cardinalities (k). The S4 model objects 'oscar' can then be passed on to various down-stream functions, such as oscar.pareto, oscar.cv, and oscar.bs, along with their supporting visualization functions.

Value

Fitted oscar-object

See Also

oscar.cv oscar.bs oscar.pareto oscar.visu oscar.cv.visu oscar.bs.visu oscar.pareto.visu oscar.binplot

Examples

```
if(interactive()){
  data(ex)
  fit <- oscar(x=ex_X, y=ex_Y, k=ex_K, w=ex_c, family='cox')
  fit
}
```

`oscar-class` *S4-class for oscar*

Description

S4-class for oscar

`oscar.binarize` *Binary logical indicator matrix representation of an oscar object's coefficients (zero vs. non-zero, i.e. feature inclusion)*

Description

Create a sparse matrix with binary indicator 1 indicating that a coefficient was non-zero, and value 0 (or . in sparse matrix) indicating that a coefficient was zero (i.e. feature not included)

Usage

```
oscar.binarize(fit, kmax = fit@kmax)
```

Arguments

`fit`	Fit oscar-model object
`kmax`	Create matrix until kmax-value; by default same as for fit object, but for high dimensional tasks one may wish to reduce this

Details

The matrix consists of TRUE/FALSE values, and is very similar to the oscar.sparsify, where the function provides estimate values in a sparse matrix format.

Value

A binary logical indicator matrix of variables (rows) as a function of cardinality k (columns), where elements are binary indicators for 1 as non-zero and 0 as zero.

Examples

```
if(interactive()){
  data(ex)
  fit <- oscar(x=ex_X, y=ex_Y, k=ex_K, w=ex_c, family='cox')
  oscar.binarize(fit, kmax=5)
}
```

`oscar.binplot` *Visualize binary indicator matrix optionally coupled with cross-validation performance for oscar models*

Description

This visualization function makes use of the sparsified beta-coefficient matrix form as a function of cardinality. Optionally, user may showcase cross-validation performance alongside at the same cardinality values.

Usage

```
oscar.binplot(
  fit,
  cv,
  kmax,
  collines = TRUE,
  rowlines = TRUE,
  cex.axis = 0.6,
  heights = c(0.2, 0.8),
  ...
)
```

Arguments

`fit`	Fitted oscar S4-class object
`cv`	Matrix produced by oscar.cv; rows are cv-folds, cols are k-values
`kmax`	Maximum cardinality 'k'
`collines`	Should vertical lines be drawn to bottom part
`rowlines`	Should horizontal lines be drawn to highlight variables
`cex.axis`	Axis magnification
`heights`	Paneling proportions as a numeric vector of length 2
`...`	Additional parameters passed on to hamlet::hmap

Value

This is a plotting function that does not return anything, but instead draws on a new graphics device.

Examples

```
if(interactive()){
  data(ex)
  fit <- oscar(x=ex_X, y=ex_Y, k=ex_K, w=ex_c, family='cox')
  fit_cv <- oscar.cv(fit, fold = 10, seed = 123)
  oscar.binplot(fit=fit, cv=fit_cv)
}
```

`oscar.bs` *Bootstrapping for oscar-fitted model objects*

Description

This model bootstraps the fitting of a given oscar object (re-fits the model for data that is equal in size but sampled with replacement). The output objects give insight into robustness of the oscar-coefficient path, as well as relative importance of model objects.

Usage

```
oscar.bs(fit, bootstrap = 100, seed = NULL, verb = 0, ...)
```

Arguments

`fit`	oscar-model object
`bootstrap`	Number of bootstrapped datasets, Default: 100
`seed`	Random seed for reproducibility with NULL indicating that it is not set, Default: NULL
`verb`	Level of verbosity with higher integer giving more information, Default: 0
`...`	Additional parameters passed to oscar-function

Details

The function provides a fail-safe try-catch in an event of non-convergence of the model fitting procedure. This may occur for example if a bootstrapped data matrix has a column consist of a single value only over all observations.

Value

3-dimensional array with dimensions corresponding to k-steps, beta coefficients, and bootstrap runs

Examples

```
if(interactive()){
  data(ex)
  fit <- oscar(x=ex_X, y=ex_Y, k=ex_K, w=ex_c, family='cox')
  fit_bs <- oscar.cv(fit, bootstrap = 20, seed = 123)
  fit_bs
}
```

oscar.bs.boxplot *Bootstrap visualization with boxplot, percentage of new additions*

Description

This function plots as barplots as a function of k-cardinality in what proporties certain coefficients were chosen as non-zero over the bootstrap runs.

Usage

```
oscar.bs.boxplot(bs, ...)
```

Arguments

bs	Bootstrapped 3-dimensional array for an oscar object as produced by oscar.bs
...	Additional parameters passed on to barplot

Value

This is a plotting function that does not return anything, but instead draws on a new graphics device.

Examples

```
if(interactive()){
  data(ex)
  fit <- oscar(x=ex_X, y=ex_Y, k=ex_K, w=ex_c, family='cox')
  fit_bs <- oscar.bs(fit, bootstrap = 20, seed = 123)
  oscar.bs.boxplot(fit_bs)
}
```

oscar.bs.k *Reformatting bootstrap output for cardinality k rows*

Description

The function reformats bootstrapped runs to a single long data.frame, where all bootstrapped runs are covered along with the choices for the variables at each cardinality 'k'.

Usage

```
oscar.bs.k(bs)
```

Arguments

bs	Bootstrapped list from oscar.bs

Value

Reformatted data.frame

Examples

```
if(interactive()){
  data(ex)
  fit <- oscar(x=ex_X, y=ex_Y, k=ex_K, w=ex_c, family='cox')
  fit_bs <- oscar.bs(fit, bootstrap = 20, seed = 123)
  ll <- oscar.bs.k(fit_bs)
  head(ll)
  tail(ll)
}
```

`oscar.bs.plot` *Bootstrap heatmap plot for oscar models*

Description

This function neatly plots a colourized proportion of variables chosen as a function of cardinalities over a multitude of bootstrap runs. This helps model diagnostics in assesssing variable importance.

Usage

```
oscar.bs.plot(
  fit,
  bs,
  kmax,
  cex.axis = 0.6,
 palet = colorRampPalette(c("orange", "red", "black", "blue", "cyan"))(dim(bs)[3]),
  nbins = dim(bs)[3],
  Colv = NA,
  Rowv = NA,
  ...
)
```

Arguments

`fit`	Fitted oscar S4-class object
`bs`	Bootstrapped 3-dimensional array for an oscar object as produced by oscar.bs
`kmax`	Maximum cardinality 'k'
`cex.axis`	Axis magnification
`palet`	Colour palette
`nbins`	Number of bins (typically ought to be same as number of colours in the palette)
`Colv`	Column re-ordering indices or a readily built dendrogram
`Rowv`	Row re-ordering indices or a readily built dendrogram
`...`	Additional parameters passed on to the hamlet::hmap function

Details

Further heatmap parameters available from ?hmap

Value

This is a plotting function that does not return anything, but instead draws on a new graphics device.

Examples

```
if(interactive()){
  data(ex)
  fit <- oscar(x=ex_X, y=ex_Y, k=ex_K, w=ex_c, family='cox')
  fit_bs <- oscar.bs(fit, bootstrap = 20, seed = 123)
  oscar.bs.plot(fit, fit_bs)
}
```

---

oscar.bs.visu *Visualize bootstrapping of a fit oscar object*

Description

This function visualizes bootstrapped model coefficients over multiple bootstrap runs as lines in a graph

Usage

```
oscar.bs.visu(bs, intercept = FALSE, add = FALSE)
```

Arguments

bs	Bootstrapped 3-dimensional array for an oscar object as produced by oscar.bs
intercept	Whether model intercept should be plotted also as a coefficient, Default: FALSE
add	Should plot be added on top of an existing plot device

Value

This is a plotting function that does not return anything, but instead draws on an existing or a new graphics device.

Examples

```
if(interactive()){
  data(ex)
  fit <- oscar(x=ex_X, y=ex_Y, k=ex_K, w=ex_c, family='cox')
  fit_bs <- oscar.bs(fit, bootstrap = 20, seed = 123)
  oscar.bs.visu(fit_bs)
}
```

`oscar.control` *Control OSCAR optimizer parameters*

Description

Fine-tuning the parameters available for the DBDC and LMBM optimizers. See oscar documentation for the optimization algorithms for further details.

Usage

```
oscar.control(
  x,
  family,
  start = 2,
  in_mrounds = 5000,
  in_mit = 5000,
  in_mrounds_esc = 5000,
  in_b1,
  in_b2 = 3,
  in_b,
  in_m = 0.01,
  in_m_clarke = 0.01,
  in_c = 0.1,
  in_r_dec,
  in_r_inc = 10^5,
  in_eps1 = 5 * 10^(-5),
  in_eps,
  in_crit_tol = 10^(-5),
  na = 4,
  mcu = 7,
  mcinit = 7,
  tolf = 10^(-5),
  tolf2 = 10^4,
  tolg = 10^(-5),
  tolg2 = tolg,
  eta = 0.5,
  epsL = 0.125
)
```

Arguments

`x`	Input data matrix 'x'; will be used for calculating various control parameter defaults.
`family`	Model family; should be one of 'cox', 'logistic', or 'gaussian'/'mse'
`start`	Starting point generation method, see vignettes for details; should be an integer between range,range, Default: 2

in_mrounds	DBDC: The maximum number of rounds in one main iteration, Default: 5000
in_mit	DBDC: The maximum number of main iterations, Default: 5000
in_mrounds_esc	DBDC: The maximum number of rounds in escape procedure, Default: 5000
in_b1	DBDC: The size of bundle B1, Default: min(n_feat+5,1000)
in_b2	DBDC: The size of bundle B2, Default: 3
in_b	DBDC: Bundle B in escape procedure, Default: 2*n_feat
in_m	DBDC: The descent parameter in main iteration, Default: 0.01
in_m_clarke	DBDC: The descent parameter in escape procedure, Default: 0.01
in_c	DBDC: The extra decrease parameter in main iteration, Default: 0.1
in_r_dec	DBDC: The decrease parameter in main iteration, Default: 0.75, 0.99, or larger depending on n_obs (thresholds 10, 300, and above)
in_r_inc	DBDC: The increase parameter in main iteration, Default: 10^5
in_eps1	DBDC: The enlargement parameter, Default: 5*10^(-5)
in_eps	DBDC: The stopping tolerance (proximity measure), Default: 10^(-6) if number of features is <= 50, otherwise 10^(-5)
in_crit_tol	DBDC: The stopping tolerance (criticality tolerance), Default: 10^(-5)
na	LMBM: Size of the bundle, Default: 4
mcu	LMBM: Upper limit for maximum number of stored corrections, Default: 7
mcinit	LMBM: Initial maximum number of stored corrections, Default: 7
tolf	LMBM: Tolerance for change of function values, Default: 10^(-5)
tolf2	LMBM: Second tolerance for change of function values, Default: 10^4
tolg	LMBM: Tolerance for the first termination criterion, Default: 10^(-5)
tolg2	LMBM: Tolerance for the second termination criterion, Default: same as 'tolg'
eta	LMBM: Distance measure parameter (>0), Default: 0.5
epsL	LMBM: Line search parameter (0 < epsL < 0.25), Default: 0.125

Details

This function sanity checks and provides reasonable DBDC ('Double Bundle method for non-smooth DC optimization' as described in Joki et al. (2018) <doi:10.1137/16M1115733>) and LMBM ('Limited Memory Bundle Method for large-scale nonsmooth optimization' as presented in Haarala et al. (2004) <doi:10.1080/10556780410001689225>) optimization tuning parameters. User may override custom values, though sanity checks will prevent unreasonable values and replace them. The returned list of parameters can be provided for the 'control' parameter when fitting oscar-objects.

Value

A list of sanity checked parameter values for the OSCAR optimizers.

Examples

```
if(interactive()){
  oscar.control() # Return a list of default parameters
}
```

oscar.cost.after — *Return total cost of model fits if the cost is not included in the oscar object*

Description

If at least one measurement from a kit is included in the model, the kit cost is added.

Usage

```
oscar.cost.after(object)
```

Arguments

object	Fit oscar S4-object

Value

A vector for numeric values of total kit costs at different cardinalities.

Examples

```
if(interactive()){
  data(ex)
  fit <- oscar(x=ex_X, y=ex_Y, k=ex_K, w=ex_c, family='cox')
  oscar.cost.after(fit)
}
```

oscar.cv — *Cross-validation for oscar-fitted model objects over k-range*

Description

Create a cross-validation matrix with the chosen goodness metric with n-folds. Based on the goodness metric, one ought to pick optimal cardinality (parameter 'k').

Usage

```
oscar.cv(
  fit,
  fold = 10,
  seed = NULL,
  strata = rep(1, times = nrow(fit@x)),
  verb = 0,
  ...
)
```

Arguments

fit	oscar-model object
fold	Number of cross-validation folds, Default: 10
seed	Random seed for reproducibility with NULL indicating that it is not set, Default: NULL
strata	Should stratified cross-validation be used; separate values indicate balanced strata. Default: Unit vector, which will treat all observations equally.
verb	Level of verbosity with higher integer giving more information, Default: 0
...	Additional parameters passed to oscar-function

Details

A k-fold cross-validation is run by mimicking the parameters contained in the original oscar S4-object. This requires the original data at slots @x and @y.

Value

A matrix with goodness of fit over folds and k-values

Examples

```
if(interactive()){
  data(ex)
  fit <- oscar(x=ex_X, y=ex_Y, k=ex_K, w=ex_c, family='cox')
  fit_cv <- oscar.cv(fit, fold=10, seed=123)
  fit_cv
}
```

---

oscar.cv.visu *Visualize cross-validation as a function of k*

Description

This function plots the model performance as a function of cardinality for k-fold cross-validation. Performance metric depends on user choice and model family (i.e. lower MSE is good, higher C-index is good).

Usage

```
oscar.cv.visu(
  cv,
  add = FALSE,
  main = "OSCAR cross-validation",
  xlab = "Cardinality 'k'",
  ylab = "CV performance",
  ...
)
```

Arguments

cv	Matrix produced by oscar.cv; rows are cv-folds, cols are k-values
add	Should plot be added on top of an existing plot device
main	Main title
xlab	X-axis label
ylab	Y-axis label
...	Additional parameters passed on top the CV points

Value

This is a plotting function that does not return anything, but instead draws on an existing or a new graphics device.

Examples

```
if(interactive()){
  data(ex)
  fit <- oscar(x=ex_X, y=ex_Y, k=ex_K, w=ex_c, family='cox')
  fit_cv <- oscar.cv(fit, fold = 10, seed = 123)
  oscar.cv.visu(fit_cv)
}
```

---

oscar.pareto *Retrieve a set of pareto-optimal points for an oscar-model based on model goodness-of-fit or cross-validation*

Description

This function retrieves the set of pareto optimal points for an oscar model fit in n-proportional time as cardinality axis is readily sorted. It is advisable to optimize model generalization (via cross-validation) rather than mere goodness-of-fit.

Usage

```
oscar.pareto(fit, cv, xval = "cost", weak = FALSE, summarize = mean)
```

Arguments

fit	Fit oscar S4-object
cv	A cross-validation matrix as produced by oscar.cv; if CV is not provided, then goodness-of-fit from fit object itself is used rather than cross-validation generalization metric
xval	The x-axis to construct pareto front based on; by default 'cost' vector for features/kits, can also be 'cardinality'/'k'
weak	If weak pareto-optimality is allowed; by default FALSE.
summarize	Function that summarizes over cross-validation folds; by default, this is the mean over the k-folds.

Value

A data.frame containing points and indices at which pareto optimal points exist

Examples

```
if(interactive()){
  data(ex)
  fit <- oscar(x=ex_X, y=ex_Y, k=ex_K, w=ex_c, family='cox')
  fit_cv <- oscar.cv(fit, fold=10)
  oscar.pareto(fit, cv=fit_cv)
}
```

---

oscar.pareto.visu *Visualize oscar model pareto front*

Description

Visualization function for showing the pareto front for cardinality 'k' and model goodness metric, either from goodness-of-fit or from cross-validation

Usage

```
oscar.pareto.visu(
  fit,
  cv,
  xval = "cost",
  weak = FALSE,
  summarize = mean,
  add = FALSE,
  ...
)
```

Arguments

fit	Fit oscar S4-object
cv	A cross-validation matrix as produced by oscar.cv; if CV is not provided, then goodness-of-fit from fit object itself is used rather than cross-validation generalization metric
xval	The x-axis to construct pareto front based on; by default 'cost' vector for features/kits, can also be 'cardinality'/'k'
weak	If weak pareto-optimality is allowed; by default FALSE.
summarize	Function that summarizes over cross-validation folds; by default, this is the mean over the k-folds.
add	If the fit should be added on top of an existing plot; in that case leaving out labels etc. By default new plot is called.
...	Additional parameters provided for the plotting functions

Value

This is a plotting function that does not return anything, but instead draws on an existing or a new graphics device.

Examples

```
if(interactive()){
  data(ex)
  fit <- oscar(x=ex_X, y=ex_Y, k=ex_K, w=ex_c, family='cox')
  fit_cv <- oscar.cv(fit, fold = 10, seed = 123)
  opar <- par(mfrow=c(1,2))
  oscar.pareto.visu(fit=fit) # Model goodness-of-fit
  oscar.pareto.visu(fit=fit, cv=fit_cv) # Model cross-validation performance
  par(opar)
}
```

---

oscar.sparsify *Create a sparse matrix representation of betas as a function of k*

Description

Variable estimates (rows) as a function of cardinality (k, columns). Since a model can drop out variables in favor of two better ones as k increases, this sparse representation helps visualize which variables are included at what cardinality.

Usage

```
oscar.sparsify(fit, kmax = fit@kmax)
```

Arguments

fit	oscar-model object
kmax	Create matrix until kmax-value; by default same as for fit object, but for high dimensional tasks one may wish to reduce this

Details

Uses sparseMatrix-class from Matrix-package

Value

A sparse matrix of variables (rows) as a function of cardinality k (columns), where elements are the beta estimates.

Examples

```
if(interactive()){
  data(ex)
  fit <- oscar(x=ex_X, y=ex_Y, k=ex_K, w=ex_c, family='cox')
  oscar.sparsify(fit, kmax=5)
}
```

`oscar.visu` *Target function value and total kit cost as a function of number of kits included*

Description

Plot oscar S4-object goodness-of-fit, kit costs, and similar performance metrics.

Usage

```
oscar.visu(
  fit,
  y = c("target", "cost", "goodness", "cv", "AIC"),
  cols = c("red", "blue"),
  legend = "top",
  mtexts = TRUE,
  add = FALSE,
  main = ""
)
```

Arguments

`fit`	Fitted oscar S4-class object
`y`	Plotted y-axes supporting two simultaneous axes with different scales, Default: c("target", "cost", "goodness", "cv")
`cols`	Colours for drawn lines, Default: c("red", "blue")
`legend`	Location of legend or omission of legend with NA, Default: 'top'
`mtexts`	Outer margin texts
`add`	Should plot be added into an existing frame / plot
`main`	Main title

Value

This is a plotting function that does not return anything, but instead draws on an existing or a new graphics device.

Examples

```
if(interactive()){
  data(ex)
  fit <- oscar(x=ex_X, y=ex_Y, k=ex_K, w=ex_c, family='cox')
  oscar.visu(fit, y=c("target", "cost"))
}
```

`show,oscar-method` *Showing oscar-objects*

Description

Showing oscar-objects

Usage

```
## S4 method for signature 'oscar'
show(object)
```

Arguments

`object`	Fit oscar S4-object

Value

Outputs raw text describing key characteristics of the oscar-object

Index

coef,oscar-method, 3
cost, 4
cost,oscar-method *(*cost*)*, 4
cost,oscar-methods *(*cost*)*, 4

ex_c *(*Example data*)*, 4
ex_K *(*Example data*)*, 4
ex_X *(*Example data*)*, 4
ex_Y *(*Example data*)*, 4
Example data, 4

feat, 5
feat,oscar-method *(*feat*)*, 5
feat,oscar-methods *(*feat*)*, 5

kits, 5
kits,oscar-method *(*kits*)*, 5
kits,oscar-methods *(*kits*)*, 5

oscar, 6
oscar-class, 8
oscar-package, 2
oscar.binarize, 8
oscar.binplot, *7*, 9
oscar.bs, *7*, 10
oscar.bs.boxplot, 11
oscar.bs.k, 11
oscar.bs.plot, 12
oscar.bs.visu, *7*, 13
oscar.control, 14
oscar.cost.after, 16
oscar.cv, *7*, 16
oscar.cv.visu, *7*, 17
oscar.pareto, *7*, 18
oscar.pareto.visu, *7*, 19
oscar.sparsify, 20
oscar.visu, *7*, 21

plot,oscar-method *(*coef,oscar-method*)*, 3
predict,oscar-method
*(*coef,oscar-method*)*, 3

show,oscar-method, 22