

# Package ‘o2plsda’

October 14, 2022

**Type** Package

**Title** Multiomics Data Integration

**Version** 0.0.18

**Description** Provides functions to do 'O2PLS-DA' analysis for multiple omics data integration.

The algorithm came from "O2-PLS, a two-block ( $X \pm Y$ ) latent variable regression (LVR) method with an integral OSC filter" which published by Johan Trygg and Svante Wold at 2003 <[doi:10.1002/cem.775](https://doi.org/10.1002/cem.775)>. 'O2PLS' is a bidirectional multivariate regression method that aims to separate the covariance between two data sets (it was recently extended to multiple data sets) (Löfstedt and Trygg, 2011 <[doi:10.1002/cem.1388](https://doi.org/10.1002/cem.1388)>; Löfstedt et al., 2012 <[doi:10.1016/j.aca.2013.06.026](https://doi.org/10.1016/j.aca.2013.06.026)>) from the systematic sources of variance being specific for each data set separately.

**License** GPL-3

**Imports** Rcpp (>= 1.0.7), dplyr, magrittr, parallel, ggplot2, ggrepel, methods, stats

**Depends**

**Encoding** UTF-8

**Suggests** knitr, markdown, rmarkdown

**VignetteBuilder** knitr

**LinkingTo** Rcpp, RcppArmadillo

**RoxygenNote** 7.1.2

**NeedsCompilation** yes

**Repository** CRAN

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**R topics documented:**

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loadings	<i>Extract the loadings from an O2PLS fit</i>
----------	---

---

**Description**

This function extracts loading parameters from an O2PLS fit

This function extracts loading parameters from an O2PLS fit

**Usage**

```
loadings(x, ...)
```

```
## S3 method for class 'O2pls'
```

```
loadings(x, loading = c("Xjoint", "Yjoint", "Xorth", "Yorth"), ...)
```

**Arguments**

x                    Object of class O2pls

...                   For consistency

loading              the loadings for one of "Xjoint", "Yjoint", "Xorth", "Yorth"

**Value**

Loading matrix

Loading matrix

---

loadings.o2plsda	<i>extract the loading value from the O2PLSDA analysis</i>
------------------	--

---

**Description**

extract the loading value from the O2PLSDA analysis

**Usage**

```
## S3 method for class 'o2plsda'  
loadings(x, loading = "Xloading", ...)
```

**Arguments**

x	Object of class o2plsda
loading	the loadings for one of "Xjoint", "Yjoint", "Xorth", "Yorth"
...	For consistency

---

loadings.plsda	<i>extract the loading value from the PLSDA analysis</i>
----------------	--

---

**Description**

extract the loading value from the PLSDA analysis

**Usage**

```
## S3 method for class 'plsda'  
loadings(x, ...)
```

**Arguments**

x	Object of class plsda
...	For consistency

---

o2cv

*Cross validation for O2PLS*

---

### **Description**

Cross validation for O2PLS

### **Usage**

```
o2cv(  
  X,  
  Y,  
  nc,  
  nx,  
  ny,  
  group = NULL,  
  nr_folds = 5,  
  ncores = 1,  
  scale = FALSE,  
  center = FALSE  
)
```

### **Arguments**

X	a Numeric matrix (input)
Y	a Numeric matrix (input)
nc	Integer. Number of joint PLS components.
nx	Integer. Number of orthogonal components in X
ny	Integer. Number of orthogonal components in Y
group	a vector to indicate the group for Y
nr_folds	Integer to indicate the folds for cross validation
ncores	Integer. Number of CPUs to use for cross validation
scale	boolean values determining if data should be scaled or not
center	boolean values determining if data should be centered or not

### **Value**

a data frame with the Q and RMSE values

### **Author(s)**

Kai Guo

**Examples**

```

set.seed(123)
X = matrix(rnorm(500),50,10)
Y = matrix(rnorm(500),50,10)
X = scale(X, scale = TRUE)
Y = scale(Y, scale = TRUE)
# group factor could be omitted if you don't have any group
group <- rep(c("Ctrl","Treat"), each = 25)
cv <- o2cv(X, Y, 1:2, 1:2, 1:2, group=group, nr_folds = 2, ncores=1)

```

o2pls

*fit O2PLS model with best nc, nx, ny***Description**

fit O2PLS model with best nc, nx, ny

**Usage**

```
o2pls(X, Y, nc, nx, ny, scale = FALSE, center = FALSE)
```

**Arguments**

X	a Numeric matrix (input)
Y	a Numeric matrix (input)
nc	Integer. Number of joint PLS components.
nx	Integer. Number of orthogonal components in X
ny	Integer. Number of orthogonal components in Y
scale	boolean values determining if data should be scaled or not
center	boolean values determining if data should be centered or not

**Value**

An object containing

Xscore	Joint X scores
Xloading	Joint X loadings
Yscore	Joint Y scores
Yloading	Joint Y loadings
TYosc	Orthogonal X scores
PYosc	Orthogonal X loadings
WYosc	Orthogonal X weights
UXosc	Orthogonal Y scores
PXosc	Orthogonal Y loadings

CXosc	Orthogonal $Y$ weights
BU	Regression coefficient in $Tt \sim U$
BT	Regression coefficient in $U \sim Tt$
R2Xhat	Prediction of $X$ with $Y$
R2Yhat	Prediction of $Y$ with $X$
R2X	Variation of the modeled part in $X$ (defined by Joint + Orthogonal variation) as proportion of total variation in $X$
R2Y	Variation of the modeled part in $Y$ (defined by Joint + Orthogonal variation) as proportion of total variation in $Y$
R2Xcorr	Variation of the joint part in $X$
R2Ycorr	Variation of the joint part in $Y$
R2Xo	Variation of the orthogonal part in $X$ as proportion of variation in $X$
R2Yo	Variation of the orthogonal part in $Y$ as proportion of variation in $Y$
R2Xp	Variation in $X$ joint part predicted by $Y$ Joint part
R2Yp	Variation in $Y$ joint part predicted by $X$ Joint part
varXj	Variation in each Latent Variable (LV) in $X$ Joint part
varYj	Variation in each Latent Variable (LV) in $Y$ Joint part
varXorth	Variation in each Latent Variable (LV) in $X$ Orthogonal part
varYorth	Variation in each Latent Variable (LV) in $Y$ Orthogonal part
E <sub>xy</sub>	Residuals in $X$
F <sub>xy</sub>	Residuals in $Y$

### Author(s)

Kai Guo

### Examples

```
set.seed(123)
X = matrix(rnorm(500),50,10)
Y = matrix(rnorm(500),50,10)
X = scale(X, scale = TRUE)
Y = scale(Y, scale = TRUE)
fit <- o2pls(X, Y, 1, 2, 2)
summary(fit)
```

---

 O2pls-class

*Class "O2pls" This class represents the Annotation information*


---

**Description**

Class "O2pls" This class represents the Annotation information

**Slots**

X a Numeric matrix (input)

Y a Numeric matrix (input)

params paramaters ysed in o2pls analysis

results list of o2pls results

**Author(s)**

Kai Guo

---

 opllda

*Orthogonal partial least squares discriminant analysis*


---

**Description**

Computes orthogonal scores partial least squares regressions with the NIPALS algorithm. It return a comprehensive set of pls outputs (e.g. scores and vip).

**Usage**

```
opllda(X, Y, nc, scale = FALSE, center = TRUE, maxiter = 100, tol = 1e-05)
```

**Arguments**

X a O2pls object or a matrix of predictor variables.

Y a single vector indicate the group

nc the number of pls components (the one joint components + number of orthogonal components ).

scale logical indicating whether X must be scaled (suggest TRUE).

center boolean values determining if data should be centered or not

maxiter maximum number of iterations.

tol limit for convergence of the algorithm in the nipals algorithm.

**Value**

a list containing the following elements:

- `nc` the number of components used (one joint components + number of orthogonal components)
- `scores` a matrix of scores corresponding to the observations in  $X$ , The components retrieved correspond to the ones optimized or specified.
- `Xloadings` a matrix of loadings corresponding to the explanatory variables. The components retrieved correspond to the ones optimized or specified.
- `Yloadings` a matrix of partial least squares loadings corresponding to  $Y$
- `vip` the VIP matrix.
- `xvar` a matrix indicating the standard deviation of each component (`sd`), the variance explained by each single component (`explained_var`) and the cumulative explained variance (`cumulative_explained_var`). These values are computed based on the data used to create the projection matrices.
- `projection_matrix` the matrix of projection matrix
- `weight` a matrix of partial least squares ("pls") weights.

**Author(s)**

Kai Guo

**Examples**

```
X <- matrix(rnorm(50),10,5)
Y <- matrix(rnorm(50),10,5)
fit <- o2pls(X,Y,2,1,1)
yy <- rep(c(0,1),5)
fit0 <- oplstda(fit,yy,2)
```

---

plot.O2pls

*Score or loading plot for the O2PLS results*

---

**Description**

Score or loading plot for the O2PLS results

**Usage**

```
## S3 method for class 'O2pls'
plot(
  x,
  type = "score",
  var = "Xjoint",
  group = NULL,
  ind = c(1, 2),
```



```

    color = NULL,
    top = 20,
    ellipse = TRUE,
    order = FALSE,
    pt.size = 3,
    label = TRUE,
    label.size = 4,
    repel = TRUE,
    rotation = FALSE,
    ...
  )

```

### Arguments

x	an O2pls object
type	score or loading
var	specify Xjoint
group	color used for score plot
ind	which components to be used for score plot or loading plot
color	color used for score or loading plot
top	the number of largest loading value to plot
ellipse	TRUE/FALSE
order	order by the value or not
pt.size	point size
label	plot label or not (TRUE/FALSE)
label.size	label size
repel	use ggrepel to show the label or not
rotation	flip the figure or not (TRUE/FALSE)
...	For consistency

### Value

a ggplot2 object

### Author(s)

Kai Guo

### Examples

```

X <- matrix(rnorm(50),10,5)
Y <- matrix(rnorm(50),10,5)
fit <- o2pls(X,Y,2,1,1)
plot(fit, type="score")

```

---

plot.o2plsda	<i>Score, VIP or loading plot for the O2PLS results</i>
--------------	---

---

**Description**

Score, VIP or loading plot for the O2PLS results

**Usage**

```
## S3 method for class 'o2plsda'
plot(
  x,
  type = "score",
  var = "Xjoint",
  group = NULL,
  ind = c(1, 2),
  color = NULL,
  top = 20,
  ellipse = TRUE,
  order = FALSE,
  pt.size = 3,
  label = TRUE,
  label.size = 4,
  repel = FALSE,
  rotation = FALSE,
  ...
)
```

**Arguments**

x	an o2plsda object
type	score, vip or loading
var	specify Xjoint
group	color used for score plot
ind	which components to be used for score plot or loading plot
color	color used for score or loading plot
top	the number of largest loading value to plot
ellipse	TRUE/FALSE
order	order by the value or not
pt.size	point size
label	plot label or not (TRUE/FALSE)
label.size	label size
repel	use ggrepel to show the label or not
rotation	flip the figure or not (TRUE/FALSE)
...	For consistency

**Value**

a ggplot2 object

**Author(s)**

Kai Guo

**Examples**

```
X <- matrix(rnorm(50),10,5)
Y <- matrix(rnorm(50),10,5)
fit <- o2pls(X,Y,2,1,1)
yy <- rep(c(0,1),5)
fit0 <- oplstda(fit,yy,2)
plot(fit0, type="score", group = factor(yy))
```

---

plot.plsda

*Score, VIP or loading plot for the plsda results*

---

**Description**

Score, VIP or loading plot for the plsda results

**Usage**

```
## S3 method for class 'plsda'
plot(
  x,
  type = "score",
  group = NULL,
  ind = c(1, 2),
  color = NULL,
  top = 20,
  ellipse = TRUE,
  order = FALSE,
  pt.size = 3,
  label = TRUE,
  label.size = 4,
  repel = FALSE,
  rotation = FALSE,
  ...
)
```

**Arguments**

x	an plsda object
type	score, vip or loading
group	color used for score plot
ind	which components to be used for score plot or loading plot
color	color used for score or loading plot
top	the number of largest loading value to plot
ellipse	TRUE/FALSE
order	order by the value or not
pt.size	point size
label	plot label or not (TRUE/FALSE)
label.size	label size
repel	use ggrepel to show the label or not
rotation	flip the figure or not (TRUE/FALSE)
...	For consistency

**Value**

a ggplot2 object

**Author(s)**

Kai Guo

**Examples**

```
X <- matrix(rnorm(500),10,50)
Y <- rep(c("a","b"),each=5)
fit0 <- plsda(X,Y,2)
plot(fit0, type = "score", group = factor(Y))
```

---

plsda

*Partial least squares discriminant analysis*

---

**Description**

Perform a PLS discriminant analysis

**Usage**

```
plsda(X, Y, nc, scale = TRUE, center = TRUE, cv = TRUE, nr_folds = 5)
```

**Arguments**

X	a matrix of predictor variables.
Y	a single vector indicate the group
nc	the number of pls components (the one joint components + number of orthogonal components ).
scale	logical indicating whether X must be scaled (suggest TRUE).
center	logical indicating whether X must be centered (suggest TRUE).
cv	logical indicating whether cross-validation will be performed or not (suggest TRUE).
nr_folds	nr_folds Integer to indicate the folds for cross validation.

**Value**

a list containing the following elements:

- nc the number of components used(one joint components + number of orthogonal components
- scores a matrix of scores corresponding to the observations in X, The components retrieved correspond to the ones optimized or specified.
- Xloadings a matrix of loadings corresponding to the explanatory variables. The components retrieved correspond to the ones optimized or specified.
- vip the VIP matrix.
- xvar variance explained of X by each single component.
- R2Y variance explained of Y by each single component.
- codePRESSThe residual sum of squares for the samples which were not used to fit the model
- codeQ2quality of cross-validation

**Author(s)**

Kai Guo

**Examples**

```
X <- matrix(rnorm(500),10,50)
Y <- rep(c("a","b"),each=5)
fit <- plsda(X,Y,2)
```

---

print.o2pls                    *Print the summary of O2PLS results.*

---

**Description**

Print the summary of O2PLS results.

**Usage**

```
## S3 method for class 'o2pls'  
print(x, ...)
```

**Arguments**

x	An O2pls object
...	For consistency

**Author(s)**

Kai Guo

**Examples**

```
X <- matrix(rnorm(50),10,5)  
Y <- matrix(rnorm(50),10,5)  
object <- o2pls(X,Y,1,1,1)  
print(object)
```

---

print.plsda                    *Print the summary of plsda results.*

---

**Description**

Print the summary of plsda results.

**Usage**

```
## S3 method for class 'plsda'  
print(x, ...)
```

**Arguments**

x	An plsda object
...	For consistency

**Author(s)**

Kai Guo

**Examples**

```
X <- matrix(rnorm(500),10,50)
Y <- rep(c("a","b"),each=5)
fit <- plsda(X,Y,2)
print(fit)
```

---

 scores

*Extract the scores from an O2PLS fit*


---

**Description**

This function extracts score matrices from an O2PLS fit

**Usage**

```
scores(x, ...)
```

**Arguments**

x	Object of class O2pls
...	For consistency

**Value**

Scores matrix

---

 scores.O2pls

*Extract the scores from an O2PLS fit*


---

**Description**

This function extracts scores parameters from an O2PLS fit

**Usage**

```
## S3 method for class 'O2pls'
scores(x, score = c("Xjoint", "Yjoint", "Xorth", "Yorth"), ...)
```

**Arguments**

x	Object of class O2pls
score	the scores matrix for one of "Xjoint", "Yjoint", "Xorth", "Yorth"
...	Other arguments

**Value**

score matrix

---

scores.o2plsda      *Extract the scores from an O2PLS DA analysis*

---

**Description**

Extract the scores from an O2PLS DA analysis

**Usage**

```
## S3 method for class 'o2plsda'  
scores(x, ...)
```

**Arguments**

x                    Object of class o2plsda  
...                  Other arguments

**Value**

score matrix

**Author(s)**

Kai Guo

---

scores.plsda      *Extract the scores PLSDA analysis*

---

**Description**

Extract the scores PLSDA analysis

**Usage**

```
## S3 method for class 'plsda'  
scores(x, ...)
```

**Arguments**

x                    Object of class plsda  
...                  Other arguments



**Value**

score matrix

**Author(s)**

Kai Guo

---

summary.o2pls      *Summary of an O2PLS object*

---

**Description**

Summary of an O2PLS object

**Usage**

```
## S3 method for class 'O2pls'  
summary(object, ...)
```

**Arguments**

object      a O2pls object  
...      For consistency

**Value**

Detail of O2PLS results

**Author(s)**

Kai Guo

**Examples**

```
X <- matrix(rnorm(50),10,5)  
Y <- matrix(rnorm(50),10,5)  
object <- o2pls(X,Y,1,1,1)  
summary(object)
```

---

summary.plsda	<i>Summary of an plsda object</i>
---------------	-----------------------------------

---

**Description**

Summary of an plsda object

**Usage**

```
## S3 method for class 'plsda'  
summary(object, ...)
```

**Arguments**

object	a plsda object
...	For consistency

**Value**

Detail of plsda results

**Author(s)**

Kai Guo

**Examples**

```
X <- matrix(rnorm(500),10,50)  
Y <- rep(c("a","b"),each=5)  
fit <- plsda(X,Y,2)  
summary(fit)
```

---

vip	<i>Extract the VIP values from the O2PLS-DA object</i>
-----	--

---

**Description**

Extract the VIP values from the O2PLS-DA object

**Usage**

```
vip(x)
```

**Arguments**

x	the o2plsda object or plsda object
---	------------------------------------

*vip*

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**Value**

a data frame

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