

# Package: FarmSelect (via r-universe)

September 7, 2024

**Title** Factor Adjusted Robust Model Selection

**Version** 1.0.3

**Description** Implements a consistent model selection strategy for high dimensional sparse regression when the covariate dependence can be reduced through factor models. By separating the latent factors from idiosyncratic components, the problem is transformed from model selection with highly correlated covariates to that with weakly correlated variables. It is appropriate for cases where we have many variables compared to the number of samples. Moreover, it implements a robust procedure to estimate distribution parameters wherever possible, hence being suitable for cases when the underlying distribution deviates from Gaussianity. See the paper on the 'FarmSelect' method, Fan et al.(2017) <[arXiv:1612.08490](https://arxiv.org/abs/1612.08490)>, for detailed description of methods and further references.

**Depends** R (>= 3.3.0)

**License** GPL-2

**Encoding** UTF-8

**LazyData** true

**Imports** graphics, stats, grDevices, utils, methods, Rcpp, ncvgreg, fBasics

**URL** <https://kbose28.github.io/FarmSelect/>

**RoxygenNote** 6.1.1

**LinkingTo** Rcpp, RcppArmadillo

**NeedsCompilation** yes

**Suggests** knitr, rmarkdown

**VignetteBuilder** knitr

**Repository** <https://kbose28.r-universe.dev>

**RemoteUrl** <https://github.com/kbose28/farmselect>

**RemoteRef** HEAD

**RemoteSha** e156a6ec67306249e1b90874aee70a24de6acce

## Contents

|                             |   |
|-----------------------------|---|
| farm.res . . . . .          | 2 |
| farm.select . . . . .       | 3 |
| FarmSelect . . . . .        | 6 |
| print.farm.select . . . . . | 6 |

|              |          |
|--------------|----------|
| <b>Index</b> | <b>8</b> |
|--------------|----------|

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|          |   |
|----------|---|
| farm.res | <i>Adjusting a data matrix for underlying factors</i> |
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### Description

Given a matrix of covariates, this function estimates the underlying factors and computes data residuals after regressing out those factors.

### Usage

```
farm.res(X, K.factors = NULL, robust = TRUE, cv = FALSE, tau = 2,
         verbose = TRUE)
```

### Arguments

|           |  |
|-----------|--|
| X         | an n x p data matrix with each row being a sample.   |
| K.factors | a <i>optional</i> number of factors to be estimated. Otherwise estimated internally. $K > 0$ .   |
| robust    | a boolean, specifying whether or not to use robust estimators for mean and variance. Default is TRUE.                                      |
| cv        | a boolean, specifying whether or not to run cross-validation for the tuning parameter. Default is FALSE. Only used if robust is TRUE.      |
| tau       | $> 0$ multiplier for the tuning parameter for Huber loss function. Default is 2. Only used if robust is TRUE and cv is FALSE. See details. |
| verbose   | a boolean specifying whether to print runtime updates to the console. Default is TRUE.   |

### Details

For details about the method, see Fan et al.(2017).

Using robust = TRUE uses the Huber's loss to estimate parameters robustly. For details of covariance estimation method see Fan et al.(2017).

Number of rows and columns of the data matrix must be at least 4 in order to be able to calculate latent factors.

Number of latent factors, if not provided, is estimated by the eigenvalue ratio test. See Ahn and Horenstein(2013). The maximum number is taken to be  $\min(n,p)/2$ . User can supply a larger number is desired.

The tuning parameter =  $\tau * \sigma * \text{optimal rate}$  where optimal rate is the optimal rate for the tuning parameter. For details, see Fan et al.(2017).  $\sigma$  is the standard deviation of the data.

**Value**

A list with the following items

|          |  |
|----------|--|
| residual | the data after being adjusted for underlying factors |
| loadings | estimated factor loadings                            |
| factors  | estimated factors                                    |
| nfactors | the number of (estimated) factors                    |

**References**

Ahn, S. C., and A. R. Horenstein (2013): "Eigenvalue Ratio Test for the Number of Factors," *Econometrica*, 81 (3), 1203–1227.

Fan J., Ke Y., Wang K., "Decorrelation of Covariates for High Dimensional Sparse Regression." <https://arxiv.org/abs/1612.08490>

**See Also**

[farm.select](#)

**Examples**

```
set.seed(100)
P = 200 #dimension
N = 50 #samples
K = 3 #nfactors
Q = 3 #model size
Lambda = matrix(rnorm(P*K, 0,1), P,K)
F = matrix(rnorm(N*K, 0,1), N,K)
U = matrix(rnorm(P*N, 0,1), P,N)
X = Lambda%*%t(F)+U
X = t(X)
output = farm.res(X) #default options
output$nfactors
output = farm.res(X, K.factors = 10) #inputting factors
names(output) #list of output
```

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farm.select

*Factor-adjusted robust model selection*

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**Description**

Given a covariate matrix and output vector, this function first adjusts the covariates for underlying factors and then performs model selection.

**Usage**

```
farm.select(X, Y, loss = c("scad", "mcp", "lasso"), robust = TRUE,
  cv = FALSE, tau = 2, lin.reg = TRUE, K.factors = NULL,
  max.iter = 10000, nfolds = ceiling(length(Y)/3), eps = 1e-04,
  verbose = TRUE)
```

**Arguments**

|           |   |
|-----------|---|
| X         | an n x p covariate matrix with each row being a sample. Must have same number of rows as the size of Y.   |
| Y         | a size n outcome vector.  |
| loss      | a character string specifying the loss function to be minimized. Must be one of "scad" (default) "mcp" or "lasso". You can just specify the initial letter.   |
| robust    | a boolean, specifying whether or not to use robust estimators for mean and variance. Default is TRUE.   |
| cv        | a boolean, specifying whether or not to run cross-validation for the tuning parameter. Default is FALSE. Only used if robust is TRUE.   |
| tau       | >0, multiplier for the tuning parameter for Huber loss function. Default is 2. Only used if robust is TRUE and cv is FALSE. See details.  |
| lin.reg   | a boolean, specifying whether or not to assume that we have a linear regression model (TRUE) or a logit model (FALSE) structure. Default is TRUE.   |
| K.factors | number of factors to be estimated. Otherwise estimated internally. K>0.   |
| max.iter  | maximum number of iterations across the regularization path. Default is 10000.  |
| nfolds    | the number of cross-validation folds. Default is ceiling(samplesize/3).   |
| eps       | Convergence threshold for model fitting using <a href="#">ncvreg</a> . The algorithm iterates until the RMSD for the change in linear predictors for any coefficient is less than eps. Default is 1e-4. |
| verbose   | a boolean specifying whether to print runtime updates to the console. Default is TRUE.  |

**Details**

For formula of how the covariates are adjusted for latent factors, see Section 3.2 in Fan et al.(2017).

The tuning parameter =  $\tau * \sigma * \text{optimal rate}$  where optimal rate is the optimal rate for the tuning parameter. For details, see Fan et al.(2017).  $\sigma$  is the standard deviation of the data.

[ncvreg](#) is used to fit the model after decorrelation. This package may output its own warnings about failures to converge and model saturation.

**Value**

A list with the following items

|             |   |
|-------------|---|
| model.size  | the size of the model                             |
| beta.chosen | the indices of the covariates chosen in the model |

coef.chosen      the coefficients of the chosen covariates  
 X.residual      the residual covariate matrix after adjusting for factors  
 nfactors        number of (estimated) factors  
 n                number of observations  
 p                number of dimensions  
 robust          whether robust parameters were used  
 loss             loss function used

#' @details Number of rows and columns of the covariate matrix must be at least 4 in order to be able to calculate latent factors.

## References

Fan J., Ke Y., Wang K., "Decorrelation of Covariates for High Dimensional Sparse Regression."  
<https://arxiv.org/abs/1612.08490>

## See Also

[print.farm.select farm.res](#)

## Examples

```
##linear regression
set.seed(100)
P = 200 #dimension
N = 50 #samples
K = 3 #nfactors
Q = 3 #model size
Lambda = matrix(rnorm(P*K, 0,1), P,K)
F = matrix(rnorm(N*K, 0,1), N,K)
U = matrix(rnorm(P*N, 0,1), P,N)
X = Lambda%*%t(F)+U
X = t(X)
beta_1 = rep(5,Q)
beta = c(beta_1, rep(0,P-Q))
eps = rt(N, 2.5)
Y = X%*%beta+eps

##with default options
output = farm.select(X,Y) #robust, no cross-validation
output$beta.chosen #variables selected
output$coef.chosen #coefficients of selected variables

#examples of other robustification options
output = farm.select(X,Y,robust = FALSE) #non-robust
output = farm.select(X,Y, tau = 3) #robust, no cross-validation, specified tau
#output = farm.select(X,Y, cv= TRUE) #robust, cross-validation: LONG RUNNING!

##changing the loss function and inputting factors
output = farm.select(X, Y,loss = "mcp", K.factors = 4)
```

```

##use a logistic regression model, a larger sample size is desired.
## Not run:
set.seed(100)
P = 400 #dimension
N = 300 #samples
K = 3 #nfactors
Q = 3 #model size
Lambda = matrix(rnorm(P*K, 0,1), P,K)
F = matrix(rnorm(N*K, 0,1), N,K)
U = matrix(rnorm(P*N, 0,1), P,N)
X = Lambda%*%t(F)+U
X = t(X)
beta_1 = rep(5, Q)
beta = c(beta_1, rep(0,P-Q))
eps = rnorm(N)
Prob = 1/(1+exp(-X%*%beta))
Y = rbinom(N, 1, Prob)

output = farm.select(X,Y, lin.reg=FALSE, eps=1e-3)
output$beta.chosen
output$coef.chosen

## End(Not run)

```

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FarmSelect

*FarmSelect: Factor Adjusted Robust Model Selection*


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### Description

This R package implements a consistent model selection strategy for high dimensional sparse regression when the covariate dependence can be reduced through factor models. By separating the latent factors from idiosyncratic components, the problem is transformed from model selection with highly correlated covariates to that with weakly correlated variables. It is appropriate for cases where we have many variables compared to the number of samples. Moreover, it implements a robust procedure to estimate distribution parameters wherever possible, hence being suitable for cases when the underlying distribution deviates from Gaussianity, which is commonly assumed in the literature. See the paper on this method, Fan et al.(2017) <<https://arxiv.org/abs/1612.08490>>, for detailed description of methods and further references. For detailed information on how to use and install see <https://kbose28.github.io/FarmSelect>.

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print.farm.select

*Summarize and print the results of the model selection*


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### Description

Print method for farm.select objects

## Usage

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

## Arguments

x                    A farm.select object.  
...                   Further arguments passed to or from other methods.

## Value

A list with the following items:

|             |   |
|-------------|---|
| model.size  | the size of the model                                     |
| beta.chosen | the indices of the covariates chosen in the model         |
| coef.chosen | the coefficients of the chosen covariates                 |
| X.residual  | the residual covariate matrix after adjusting for factors |
| nfactors    | number of (estimated) factors                             |
| n           | number of observations                                    |
| p           | number of dimensions                                      |
| robust      | whether robust parameters were used                       |
| loss        | loss function used  |

## See Also

[farm.select](#)

## Examples

```
set.seed(100)  
P = 200 #dimension  
N = 50 #samples  
K = 3 #nfactors  
Q = 3 #model size  
Lambda = matrix(rnorm(P*K, 0,1), P,K)  
F = matrix(rnorm(N*K, 0,1), N,K)  
U = matrix(rnorm(P*N, 0,1), P,N)  
X = Lambda%*%t(F)+U  
X = t(X)  
beta_1 = rep(5,Q)  
beta = c(beta_1, rep(0,P-Q))  
eps = rt(N, 2.5)  
Y = X%*%beta+eps  
  
##with default options  
output = farm.select(X,Y)  
output
```

# Index

`farm.res`, [2](#), [5](#)  
`farm.select`, [3](#), [3](#), [7](#)  
`FarmSelect`, [6](#)  
`FarmSelect-package (FarmSelect)`, [6](#)  
`ncvreg`, [4](#)  
`print.farm.select`, [5](#), [6](#)