

# Package ‘FPERMANOVA’

August 31, 2016

**Type** Package

**Title** Fast PERMANOVA (FPERMANOVA)

**Version** 1.0

**Date** 2016-08-30

**Depends** R(>= 3.1.0)

**Imports** PearsonDS

**Author** Xiang Zhan and Michael C. Wu

**Maintainer** Xiang Zhan <xiangzhan9@gmail.com>

**Description** This package calculates the PERMANOVA p-value in a fast and permutation-free manner

**License** GPL (>=2)

## R topics documented:

FPERMANOVA	1
tr	2
<b>Index</b>	<b>4</b>

---

FPERMANOVA	<i>Fast PERMANOVA</i>
------------	-----------------------

---

## Description

This function calculates the PERMANOVA p-value in a fast and permutation-free manner.

## Usage

```
FPERMANOVA(X, D, perbB = 10^6)
```

## Arguments

X	Design matrix with predictor variables
D	Distance matrix based on response variables
perbB	The number of perbutations/re-samples used for calculating p-value

## Details

It first calculates matrices H and G, where  $H = X(X'X)^{-1}X'$  is the projection/hat matrix based on predictor variables, and G is the Gower's centered similarity matrix calculated from distance matrix D based on the procedure described in McArdle and Anderson (2001). Then, the pseudo-F statistic can be calculated from H and G.

Instead of calculating the p-value by explicitly drawing permutations and re-calculating the pseudo-F statistic via matrix multiplication, FPERMANOVA studies the distribution of the numerator  $\text{tr}(HG)$  of the pseudo-F statistic, which is the only part changes across permutations. The permutation distribution of  $\text{tr}(HG)$  is approximated by the Pearson type III distribution by matching the first three moments. Then, replicated samples of  $\text{tr}(HG)$  are drawn from the approximated Pearson type III distribution, and are used to calculate resamplings of the pseudo-F statistic. Finally, p-value is calculated by comparing the observed pseudo-F statistic and the re-sampled pseudo-F statistics.

## Value

F	Observed $\text{tr}(HG)$ statistic
mean	Sample mean of all n! possible permutations of $\text{tr}(HG)$
var	Sample variance of all n! possible permutations of $\text{tr}(HG)$
skew	Sample skewness of all n! possible permutations of $\text{tr}(HG)$
pvalue	P-value of FPERMANOVA based on the perbutated resamples

## References

- McArdle, B. H. and Anderson, M. J. (2001). Fitting multivariate models to community data: a comment on distance-based redundancy analysis. *Ecology*, 82, 290-297.
- Zhan, X. and Wu, M. C. (2016). FPERMANOVA: A fast permutation-free PERMANOVA procedure. Technical Report.
- R package PearsonDS version 0.98.

## Examples

```
X=matrix(rnorm(20*3,0,1),20,3)
Y=matrix(rnorm(20*100,0,1),20,100)
D=as.matrix(dist(Y, method="euclidean"))
FPERMANOVA(X,D,perbB=10^5)
```

---

tr *Trace of A Matrix*

---

## Description

This function calculates the trace of a given numeric square matrix. The trace function is called by function FPERMANOVA.

## Usage

```
tr(x)
```

## Arguments

x A square matrix

**Value**

A numeric value which is the sum of the values on the diagonal.

**See Also**

[FPERMANOVA](#)

**Examples**

```
A=matrix(seq(1:9),nrow=3,ncol=3)  
tr(A)
```

# Index

FPERMANOVA, 1, 3

tr, 2