Package ‘AICcPermanova’

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Title  Model Selection of PERMANOVA Models Using AICc

Version  0.0.2

Description  Provides tools for model selection and model averaging of PerMANOVA models using Akaike Information Criterion corrected for small sample sizes (AICc) and Information Theoretic criteria principles. The package is built around the PERMANOVA analysis from the ‘vegan’ package and provides a streamlined workflow for generating and comparing models, obtaining model weights, and summarizing results using model averaging approaches. The methods implemented in this package are based on the practical information-theoretic approach described by Burnham, K. P. and Anderson, D. R. (2002) (<doi:10.1007/b97636>).

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BugReports  https://github.com/Sustainscapes/AICcPerm/issues

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| AICc_permanova2 | Calculate AICc for a permutational multivariate analysis of variance (PERMANOVA) |

**Description**

#' This function calculates the Akaike’s Information Criterion (AICc) for a permutational multivariate analysis of variance (PERMANOVA) model. The AICc is a modified version of the Akaike Information Criterion (AIC) that is more appropriate for small sample sizes and high-dimensional models.

**Usage**

`AICc_permanova2(adonis2_model)`

**Arguments**

- `adonis2_model` An object of class adonis2 from the vegan package

**Details**

The AICc calculation for a PERMANOVA model is:

\[
AICc = AIC + \frac{2k(k + 1)}{n - k - 1}
\]

where AIC is the Akaike Information Criterion, k is the number of parameters in the model (excluding the intercept), and n is the number of observations.

**Value**

A data frame with the AICc, the number of parameters (k) and the number of observations (N).

**References**

akaike_adjusted_rsq

See Also

adonis2

Examples

library(vegan)
data(dune)
data(dune.env)

# Run PERMANOVA using adonis2
Model <- adonis2(dune ~ Management*A1, data = dune.env)

# Calculate AICc
AICc_permanova2(Model)

---

akaike_adjusted_rsq  Akaike-Adjusted R Squared Calculation with Model Averaging

Description

Calculates the adjusted R squared for each predictor using the Akaike Information Criterion (AIC) and model averaging. AIC is used to compare the performance of candidate models and select the best one. Then, the R squared is adjusted based on the weight of evidence in favor of each model. The final result is a long-format table of variable names and corresponding adjusted R squared values.

Usage

akaike_adjusted_rsq(DF)

Arguments

DF  A data.frame containing the variables to calculate the adjusted R squared for. The data.frame should include the columns: "form", "AICc", "max_vif", "k", "DeltaAICc", "AICWeight", and "N".

Details

The adjusted R squared is calculated as:

\[
Adjusted R^2 = 1 - (RSS/(N - k - 1)) \times ((N - 1)/(N - k - 1))
\]

where RSS is the residual sum of squares, N is the sample size, and k is the number of predictors. The R squared is adjusted based on the weight of evidence in favor of each model, which is calculated as:

\[
w_i = \frac{\exp(-0.5 \times \text{DeltaAIC}_c)}{\sum \exp(-0.5 \times \text{DeltaAIC}_c)}
\]
where \( w_i \) is the weight of evidence in favor of the \( i \)th model, and \( \Delta\text{AICc}_i \) is the difference in AICc between the \( i \)th model and the best model. Model averaging uses the weights to combine the performance of different models in the final calculation of the adjusted R squared.

**Value**

A data.frame with columns "Variable" and "Full_Akaike_Adjusted_RSq". Each row represents a predictor, and its corresponding adjusted R squared value based on the Akaike-adjusted model averaging process.

**Examples**

```r
library(data.table)
df <- data.table(form = c(1,2,3),
                 AICc = c(10,20,30),
                 max_vif = c(3,4,5),
                 k = c(1,2,3),
                 DeltaAICc = c(2,5,8),
                 AICWeight = c(0.2,0.5,0.3),
                 N = c(100,100,100),
                 A1 = c(0.3, 0.5, NA),
                 A2 = c(0.7, NA, 0.2),
                 A3 = c(0.2, 0.3, 0.6))
akaike_adjusted_rsq(df)
```

**filter_vif**

*Filters out equations with high multicollinearity*

**Description**

This function takes a dataframe with several models and calculates the maximum Variance Inflation Factor (VIF) for a given model. And either filters out the ones with high collinearity or it flags them accordingly.

**Usage**

```r
filter_vif(all_forms, env_data, ncores = 2, filter = TRUE, verbose = TRUE)
```

**Arguments**

- **all_forms** A data frame generated by `make_models`
- **env_data** A dataset with the variables described in all_forms
- **ncores** An integer specifying the number of cores to use for parallel processing
- **filter** logical, if TRUE it filters out the models with a maximum VIF of high or higher, if FALSE it generates a new column called collinearity, which will
- **verbose** logical, defaults TRUE, sends messages about processing times
Value

A data.frame with the models, filtering out the ones with high collinearity or flagging them.

Examples

library(vegan)
data(dune)
data(dune.env)
AllModels <- make_models(vars = c("A1", "Moisture", "Manure"))

filter_vif(all_forms = AllModels,
            env_data = dune.env)

Description

This function fits PERMANOVA models for all combinations of variables in a given dataset, and arranges the models by Akaike Information Criterion (AICc) score. The function also calculates the maximum variance inflation factor (max_vif) for each model.

Usage

fit_models(
  all_forms, 
  veg_data, 
  env_data, 
  method = "bray", 
  ncores = 2, 
  log = TRUE, 
  logfile = "log.txt", 
  multiple = 100, 
  strata = NULL, 
  verbose = FALSE
)

Arguments

all_forms       A data frame generated by make_models
veg_data        A dataset with vegetation presence absense or abundance data
env_data        A dataset with the variables described in all_froms
method          method for distance from vegdist
ncores          An integer specifying the number of cores to use for parallel processing
make_models

Create models with different combinations of variables

**Description**

Generates all possible linear models for a given set of predictor variables using the distance matrix as a response variable. The function allows for the user to specify the maximum number of variables in a model, which can be useful in cases where there are many predictors. The output is a data frame containing all the possible models, which can be passed to the fit_models function for fitting using a PERMANOVA approach.

**Usage**

```r
make_models(vars, ncores = 2, k = NULL, verbose = TRUE)
```

**Arguments**

- `log`: logical if true, a log file will be generated
- `logfile`: the text file that will be generated as a log
- `multiple`: after how many loops to write a log file
- `strata`: a block variable similar to the use in `adonis2`
- `verbose`: logical, defaults TRUE, sends messages about processing times

**Value**

A data.frame with fitted models arranged by AICc, including the formula used, the number of explanatory variables, R2, adjusted R2, and the AICc and max VIF.

**References**


**Examples**

```r
library(vegan)
data(dune)
data(dune.env)

AllModels <- make_models(vars = c("A1", "Moisture", "Manure"))

fit_models(all_forms = AllModels,
  veg_data = dune,
  env_data = dune.env)
```
select_models

Arguments

- **vars**: A character vector of variables to use for modeling.
- **ncores**: An integer specifying the number of cores to use for parallel processing.
- **k**: The maximum number of variables in a model, default is NULL.
- **verbose**: Logical, defaults TRUE, sends messages about processing times.

Value

A data frame containing all the possible linear permutaova models.

References


Examples

```r
make_models(vars = c("A", "B", "C", "D"),
            ncores = 2, verbose = FALSE)
# using k as a way to limit number of variables
make_models(vars = c("A", "B", "C", "D"),
            ncores = 2, k = 2, verbose = FALSE)
```

select_models

Select models based on AICc and VIF.

Description

This function selects models from a data frame based on the AICc and VIF values. Models with AICc greater than negative infinity and VIF less than or equal to 6 are considered. The difference in AICc values for each model is calculated with respect to the model with the minimum AICc. Models with a difference in AICc less than or equal to the specified delta_aicc value are selected.

Usage

```r
select_models(df, delta_aicc = 2)
```

Arguments

- **df**: a data frame containing the models to select from.
- **delta_aicc**: a numeric value specifying the maximum difference in AICc values allowed.

Value

A data frame containing the selected models and the AIC weights.
VIF

Examples

df <- data.frame(AICc = c(10, 12, 15, 20), max_vif = c(2, 4, 5, 6))
select_models(df)
select_models(df, delta_aicc = 5)

---

Get Maximum Variance Inflation Factor (VIF) from a Model

Description

This function calculates the maximum Variance Inflation Factor (VIF) for a given model. The VIF is a measure of collinearity among predictor variables within a regression model. It quantifies how much the variance of an estimated regression coefficient is increased due to collinearity. A VIF of 1 indicates no collinearity, while values above 1 indicate increasing levels of collinearity. A VIF of 5 or greater is often considered high, indicating a strong presence of collinearity.

Usage

VIF(model)

Arguments

model A regression model, such as those created by lm, glm, or other similar functions.

Value

The maximum VIF value.

References

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