

Package ‘unusualprofile’

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Type Package

Title Calculates Conditional Mahalanobis Distances

Version 0.1.4

Description Calculates a Mahalanobis distance for every row of a set of outcome variables (Mahalanobis, 1936 [doi:10.1007/s13171-019-00164-5](https://doi.org/10.1007/s13171-019-00164-5)). The conditional Mahalanobis distance is calculated using a conditional covariance matrix (i.e., a covariance matrix of the outcome variables after controlling for a set of predictors). Plotting the output of the `cond_maha()` function can help identify which elements of a profile are unusual after controlling for the predictors.

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URL <https://github.com/wjschne/unusualprofile>,
<https://wjschne.github.io/unusualprofile/>

BugReports <https://github.com/wjschne/unusualprofile/issues>

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cond_maha	<i>Calculate the conditional Mahalanobis distance for any variables.</i>
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Description

Calculate the conditional Mahalanobis distance for any variables.

Usage

```
cond_maha(  
  data,  
  R,  
  v_dep,  
  v_ind = NULL,  
  v_ind_composites = NULL,  
  mu = 0,  
  sigma = 1,  
  use_sample_stats = FALSE,  
  label = NA  
)
```

Arguments

data	Data.frame with the independent and dependent variables. Unless mu and sigma are specified, data are assumed to be z-scores.
R	Correlation among all variables.
v_dep	Vector of names of the dependent variables in your profile.
v_ind	Vector of names of independent variables you would like to control for.

v_ind_composites	Vector of names of independent variables that are composites of dependent variables
mu	A vector of means. A single value means that all variables have the same mean.
sigma	A vector of standard deviations. A single value means that all variables have the same standard deviation
use_sample_stats	If TRUE, estimate R, mu, and sigma from data. Only complete cases are used (i.e., no missing values in v_dep, v_ind, v_ind_composites).
label	optional tag for labeling output

Value

a list with the conditional Mahalanobis distance

- dCM = Conditional Mahalanobis distance
- dCM_df = Degrees of freedom for the conditional Mahalanobis distance
- dCM_p = A proportion that indicates how unusual this profile is compared to profiles with the same independent variable values. For example, if dCM_p = 0.88, this profile is more unusual than 88 percent of profiles after controlling for the independent variables.
- dM_dep = Mahalanobis distance of just the dependent variables
- dM_dep_df = Degrees of freedom for the Mahalanobis distance of the dependent variables
- dM_dep_p = Proportion associated with the Mahalanobis distance of the dependent variables
- dM_ind = Mahalanobis distance of just the independent variables
- dM_ind_df = Degrees of freedom for the Mahalanobis distance of the independent variables
- dM_ind_p = Proportion associated with the Mahalanobis distance of the independent variables
- v_dep = Dependent variable names
- v_ind = Independent variable names
- v_ind_singular = Independent variables that can be perfectly predicted from the dependent variables (e.g., composite scores)
- v_ind_nonsingular = Independent variables that are not perfectly predicted from the dependent variables
- data = data used in the calculations
- d_ind = independent variable data
- d_inp_p = Assuming normality, cumulative distribution function of the independent variables
- d_dep = dependent variable data
- d_dep_predicted = predicted values of the dependent variables
- d_dep_deviations = d_dep - d_dep_predicted (i.e., residuals of the dependent variables)
- d_dep_residuals_z = standardized residuals of the dependent variables
- d_dep_cp = conditional proportions associated with standardized residuals
- d_dep_p = Assuming normality, cumulative distribution function of the dependent variables

- R2 = Proportion of variance in each dependent variable explained by the independent variables
- zSEE = Standardized standard error of the estimate for each dependent variable
- SEE = Standard error of the estimate for each dependent variable
- ConditionalCovariance = Covariance matrix of the dependent variables after controlling for the independent variables
- distance_reduction = $1 - (dCM / dM_dep)$ (Degree to which the independent variables decrease the Mahalanobis distance of the dependent variables. Negative reductions mean that the profile is more unusual after controlling for the independent variables. Returns 0 if dM_dep is 0.)
- variability_reduction = $1 - \text{sum}((X_dep - \text{predicted_dep})^2) / \text{sum}((X_dep - \mu_dep)^2)$ (Degree to which the independent variables decrease the variability the dependent variables (X_dep). Negative reductions mean that the profile is more variable after controlling for the independent variables. Returns 0 if X_dep == mu_dep)
- mu = Variable means
- sigma = Variable standard deviations
- d_person = Data frame consisting of Mahalanobis distance data for each person
- d_variable = Data frame consisting of variable characteristics
- label = label slot

Examples

```
library(unusualprofile)
library(simstandard)

m <- "
Gc =~ 0.85 * Gc1 + 0.68 * Gc2 + 0.8 * Gc3
Gf =~ 0.8 * Gf1 + 0.9 * Gf2 + 0.8 * Gf3
Gs =~ 0.7 * Gs1 + 0.8 * Gs2 + 0.8 * Gs3
Read =~ 0.66 * Read1 + 0.85 * Read2 + 0.91 * Read3
Math =~ 0.4 * Math1 + 0.9 * Math2 + 0.7 * Math3
Gc ~ 0.6 * Gf + 0.1 * Gs
Gf ~ 0.5 * Gs
Read ~ 0.4 * Gc + 0.1 * Gf
Math ~ 0.2 * Gc + 0.3 * Gf + 0.1 * Gs"
# Generate 10 cases
d_demo <- simstandard::sim_standardized(m = m, n = 10)

# Get model-implied correlation matrix
R_all <- simstandard::sim_standardized_matrices(m)$Correlations$R_all

cond_maha(data = d_demo,
           R = R_all,
           v_dep = c("Math", "Read"),
           v_ind = c("Gf", "Gs", "Gc"))
```

d_example

An example data.frame

Description

A dataset with 1 row of data for a single case.

Usage

```
d_example
```

Format

A data frame with 1 row and 8 variables:

X_1 A predictor variable

X_2 A predictor variable

X_3 A predictor variable

Y_1 An outcome variable

Y_2 An outcome variable

Y_3 An outcome variable

X A latent predictor variable

Y A latent outcome variable

plot.cond_maha

Plot the variables from the results of the cond_maha function.

Description

Plot the variables from the results of the cond_maha function.

Usage

```
## S3 method for class 'cond_maha'
plot(
  x,
  ...,
  p_tail = 0,
  family = "sans",
  score_digits = ifelse(min(x$sigma) >= 10, 0, 2)
)
```

Arguments

x	The results of the cond_maha function.
...	Arguments passed to print function
p_tail	The proportion of the tail to shade
family	Font family.
score_digits	Number of digits to round scores.

Value

A ggplot2-object

plot.maha	<i>Plot objects of the maha class (i.e, the results of the cond_maha function using dependent variables only).</i>
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Description

Plot objects of the maha class (i.e, the results of the cond_maha function using dependent variables only).

Usage

```
## S3 method for class 'maha'
plot(
  x,
  ...,
  p_tail = 0,
  family = "sans",
  score_digits = ifelse(min(x$sigma) >= 10, 0, 2)
)
```

Arguments

x	The results of the cond_maha function.
...	Arguments passed to print function
p_tail	Proportion in violin tail (defaults to 0).
family	Font family.
score_digits	Number of digits to round scores.

Value

A ggplot2-object

proportion2percentile	<i>Rounds proportions to significant digits both near 0 and 1, then converts to percentiles</i>
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Description

Rounds proportions to significant digits both near 0 and 1, then converts to percentiles

Usage

```
proportion2percentile(  
  p,  
  digits = 2,  
  remove_leading_zero = TRUE,  
  add_percent_character = FALSE  
)
```

Arguments

p	probability
digits	rounding digits. Defaults to 2
remove_leading_zero	Remove leading zero for small percentiles, Defaults to TRUE
add_percent_character	Append percent character. Defaults to FALSE

Value

character vector

Examples

```
proportion2percentile(0.01111)
```

proportion_round	<i>Rounds proportions to significant digits both near 0 and 1</i>
------------------	---

Description

Rounds proportions to significant digits both near 0 and 1

Usage

```
proportion_round(p, digits = 2)
```

Arguments

- p probability
- digits rounding digits

Value

numeric vector

Examples

```
proportion_round(0.01111)
```

R_example	<i>An example correlation matrix</i>
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Description

A correlation matrix used for demonstration purposes It is the model-implied correlation matrix for this structural model: $X \sim 0.7 * X_1 + 0.5 * X_2 + 0.8 * X_3$ $Y \sim 0.8 * Y_1 + 0.7 * Y_2 + 0.9 * Y_3$ $Y \sim 0.6 * X$

Usage

R_example

Format

A matrix with 8 rows and 8 columns:

- X_1** A predictor variable
- X_2** A predictor variable
- X_3** A predictor variable
- Y_1** An outcome variable
- Y_2** An outcome variable
- Y_3** An outcome variable
- X** A latent predictor variable
- Y** A latent outcome variable

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