

Package ‘RobustLPA’

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Title Robust Latent Profile Analysis

Version 0.1.0

Description Provides a comprehensive toolset for estimating Latent Profile Analysis (LPA) models that are robust to multivariate outliers and missing data. By integrating a high-performance ‘C++’ engine via ‘RcppArmadillo’ with a Full Information Maximum Likelihood (FIML) approach and Huber weighting, it reliably extracts latent profiles even in complex datasets. It supports multiple geometric variance-covariance models, along with functions for bootstrapped likelihood ratio tests and plotting. For methodological details on the Bootstrapped Likelihood Ratio Test, see Nylund et al. (2007) <[doi:10.1080/10705510701575396](https://doi.org/10.1080/10705510701575396)>. For robust clustering methods, see Garcia-Escudero et al. (2010) <[doi:10.1007/s11634-010-0064-5](https://doi.org/10.1007/s11634-010-0064-5)>.

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blrt_robust*Bootstrapped Likelihood Ratio Test for Robust LPA*

Description

Compares a robust LPA model with G profiles against a null model with $G-1$ profiles using parametric bootstrapping. Supports FIML simulation conditions.

Usage

```
blrt_robust(data, G, model = 6, n_samples = 50, n_starts = 2)
```

Arguments

<code>data</code>	A matrix or data.frame.
<code>G</code>	The number of profiles for the alternative hypothesis (compared against $G-1$).
<code>model</code>	An integer (1 to 6) specifying the variance-covariance parameterization.
<code>n_samples</code>	Number of bootstrap samples. Default is 50 for speed; 200+ is recommended for publications.
<code>n_starts</code>	Number of starts for the EM algorithm execution.

Value

A list containing the observed LRT statistic, the vector of bootstrap replicates, and the empirical p-value.

Examples

```
# Fast demonstration of the robust BLRT
data(iris)
blrt_res <- blrt_robust(iris[1:30, 1:2], G = 2, model = 1, n_samples = 2, n_starts = 1)
# Print the summary of the results
blrt_res
```

`estimate_profiles_robust`*Estimate Robust Latent Profile Models*

Description

This function provides a user-friendly interface to fit multiple robust LPA models simultaneously across different numbers of profiles and model structures, returning a comprehensive fit summary table.

Usage

```
estimate_profiles_robust(  
  data,  
  n_profiles = 1:3,  
  models = c(1, 2, 3, 4, 5, 6),  
  n_starts = 5  
)
```

Arguments

<code>data</code>	A matrix or data.frame.
<code>n_profiles</code>	A vector of integers specifying the number of profiles to run (e.g., 1:3).
<code>models</code>	A vector of LPA models to run (e.g., c(1, 2, 3, 4, 5, 6)). Default is c(1, 2, 3, 4, 5, 6).
<code>n_starts</code>	Number of initializations per model.

Value

A list containing the fit comparison table and the estimated models.

Examples

```
# Quick evaluation of multiple profiles  
data(iris)  
res <- estimate_profiles_robust(iris[1:30, 1:2], n_profiles = 1:2, models = 1, n_starts = 1)  
res$fit_table
```

plot_robust_lpa *Plot Robust Latent Profiles*

Description

Automatically generates a professional profile plot using ggplot2 from an estimated robust LPA model.

Usage

```
plot_robust_lpa(  
  model,  
  title = "Robust Latent Profiles",  
  xlab = "Variables",  
  ylab = "Value",  
  var_labels = NULL,  
  legend_title = "Class"  
)
```

Arguments

model	A model object returned by robust_lpa or estimate_profiles_robust.
title	The title of the plot. Default is "Robust Latent Profiles".
xlab	The x-axis label. Default is "Variables".
ylab	The y-axis label. Default is "Value".
var_labels	A character vector to manually rename the variables on the X axis. Default is NULL (auto-detect).
legend_title	The title of the legend. Default is "Class".

Value

A ggplot object.

Examples

```
data(iris)  
fit <- robust_lpa(data = iris[1:30, 1:2], G = 2, model = 1, n_starts = 1)  
plot_robust_lpa(fit)
```

`robust_lpa`*Fit a Single Robust Latent Profile Analysis Model*

Description

This function estimates a single robust Latent Profile Analysis (LPA) model for a specified number of profiles and model structure. It automatically handles missing data via robust FIML if present.

Usage

```
robust_lpa(data, G, model = 6, max_iter = 100, tol = 1e-06, n_starts = 5)
```

Arguments

<code>data</code>	A matrix or data.frame of observations.
<code>G</code>	The number of latent profiles to extract.
<code>model</code>	An integer (1 to 6) specifying the model parameterization.
<code>max_iter</code>	Maximum number of EM iterations.
<code>tol</code>	Tolerance for convergence.
<code>n_starts</code>	Number of random initializations.

Value

A list containing parameters, fit indices, and assignments.

Examples

```
# Quick example using a small subset of the iris dataset
data(iris)
fit <- robust_lpa(data = iris[1:30, 1:2], G = 2, model = 1, n_starts = 1)
# Print the fit indices
fit$fit
```

`robust_mean`*Calculate the robust mean*

Description

Calculate the robust mean

Usage

```
robust_mean(data, threshold = 10)
```

Arguments

data A matrix or data.frame
 threshold Maximum distance allowed to not be considered an outlier

Value

A numeric vector representing the robust mean of the variables.

Examples

```
data(iris)
r_mean <- robust_mean(iris[1:30, 1:2])

# Print the calculated robust means
r_mean
```

robust_m_step	<i>Perform a Robust M-Step for Latent Profile Analysis</i>
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Description

Perform a Robust M-Step for Latent Profile Analysis

Usage

```
robust_m_step(data, z, alpha = 0.05)
```

Arguments

data A matrix or data.frame of observations.
 z A numeric vector containing the posterior probabilities of belonging to this cluster.
 alpha Significance level for the Chi-squared outlier cutoff (default is 0.05).

Value

A list containing the robust 'mean' vector and the robust 'covariance' matrix.

Examples

```
data(iris)
# Simulate initial probabilities for a single profile
z_init <- runif(30)
z_init <- z_init / sum(z_init)

m_step_res <- robust_m_step(iris[1:30, 1:2], z = z_init)

# Print the robust mean calculated in the M-step
m_step_res$mean
```

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