Package 'StatRec'

March 18, 2025

Type Package

Title A Statistical Method for Multi-Item Rating and Recommendation
Problems

Imports Rcpp (>= 1.0.14)

Version 1.0.0

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Description Implements the methodological developments found in Her-
mes (2025) <doi:10.48550/arXiv.2503.02786>, and allows for the statistical model-
ing of data consisting of multiple users that provide an ordinal rating for one or multiple items.

License GPL-3

Encoding UTF-8

LinkingTo Rcpp, RcppArmadillo

NeedsCompilation yes

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Repository CRAN

Date/Publication 2025-03-18 15:10:13 UTC

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Description

This function applies the proposed method of Hermes (2025) on a given set of ratings, user co-
variates and item covariates. This implementation allows for the same flexibility as in the Hermes
(2025) paper, namely linear and bilinear predictors, sparsity and latent factors. Returns posterior
samples for the parameter estimates and posterior predictive samples for the missing ratings.

Usage

```
model(X, Y, R, k, l, method, sparse, mcmc_samples, burnin, verbose)
```

Arguments

X	A $n \times p$ user covariate matrix, where n is the number of users and p is the number of user covariates.
Y	A $m \times q$ item covariate matrix, where m is the number of items and q is the number of item covariates.
R	A $n \times m$ rating matrix, where missing ratings are encoded as 0 and observed ratings are encoded to be in $\{1, \ldots, k\}$.
k	Integer value indicating the maximum rating that a user can provide.
l	Number of latent factors.
method	Method choice, either `linear` or `bilinear`.
sparse	Boolean value indicating whether sparsity should be imposed on $\mathbf{B}$ (`TRUE`) or not (`FALSE`).
mcmc_samples	Total number of Gibbs samples.
burnin	Number of Gibbs samples that are used as burnin.
verbose	Boolean value indicating whether parameter estimation progress is returned (`TRUE`) or not (`FALSE`).

Value

B_hat	A $p \times q \times$ (`mcmc_samples` - `burnin`) array consisting of the post-burnin samples for the coefficients of the user and item covariates.
U_hat	A $n \times l \times$ (`mcmc_samples` - `burnin`) array consisting of the post-burnin samples for the user latent factors (only applicable if $l > 0$).
V_hat	A $m \times l \times$ (`mcmc_samples` - `burnin`) array consisting of the post-burnin samples for the item latent factors (only applicable if $l > 0$).
R_hat	A $n \times m \times$ (`mcmc_samples` - `burnin`) array consisting of the post-burnin posterior predictive samples for the missing ratings.

Author(s)

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References

1. Hermes, S. (2025). A Statistical Interpretation of Multi-Item Rating and Recommendation Problems. arXiv preprint, arXiv:2503.02786.

Examples

```
# Set parameters
n = m = 15
p = q = 3
method = "linear"
k = 5
l = 1
sparse = TRUE

# Generate some data
# this is completely random, and there is no relation between the ratings
# and the covariates or latent factors
set.seed(2025)
r = matrix(rbinom(n*m, k, 0.3), n, m)
X = matrix(rnorm(n * p), n, p)
Y = matrix(rnorm(m * q), m, q)

# Fit the model on the data
est = model(X, Y, r, k, l, method, sparse, mcmc_samples = 2000, burnin = 1000, TRUE)
```

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