

# Package ‘vimixr’

September 9, 2026

**Title** Collapsed Variational Inference for Dirichlet Process (DP)  
Mixture Model

**Version** 0.1.3

## Description

Collapsed Variational Inference for a Dirichlet Process (DP) mixture model with unknown covariance matrix structure and DP concentration parameter. It enables efficient clustering of high-dimensional data with significantly improved computational speed than traditional MCMC methods. The package incorporates 8 parameterisations and corresponding prior choices for the unknown covariance matrix, from which the user can choose and apply accordingly.

**Encoding** UTF-8

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**Imports** ggplot2, patchwork, Rcpp, Rfast, rlang, parallel, stats, irlba

**Suggests** knitr, rmarkdown, pbapply, testthat (>= 3.0.0)

**Config/testthat/edition** 3

**URL** <https://github.com/annesh07/vimixr>,  
<https://annesh07.github.io/vimixr/>

**BugReports** <https://github.com/annesh07/vimixr/issues>

**LinkingTo** Rcpp, RcppEigen

**VignetteBuilder** knitr

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|               |                      |
|---------------|----------------------|
| cum_clustprop | <i>cum_clustprop</i> |
|---------------|----------------------|

---

Description

Calculate the columnwise sum of rowwise cummulative probability

Usage

cum\_clustprop(P1)

Arguments

P1                      probability matrix

Value

rowwise cummulative probability

---

|                   |                          |
|-------------------|--------------------------|
| cum_clustprop_var | <i>cum_clustprop_var</i> |
|-------------------|--------------------------|

---

**Description**

Calculate the columnwise sum of rowwise cummulative probability for variance

**Usage**

```
cum_clustprop_var(P1)
```

**Arguments**

P1                      probability matrix

**Value**

rowwise cummulative probability for variance

---

|         |                                                                                   |
|---------|-----------------------------------------------------------------------------------|
| cvi_npm | <i>Collapsed variational inference for non-parametric Bayesian mixture models</i> |
|---------|-----------------------------------------------------------------------------------|

---

**Description**

Collapsed variational inference for non-parametric Bayesian mixture models

**Usage**

```
cvi_npm(
  X,
  variational_params,
  prior_shape_alpha,
  prior_rate_alpha,
  post_shape_alpha,
  post_rate_alpha,
  prior_mean_eta,
  post_mean_eta,
  log_prob_matrix = NULL,
  maxit = 100,
  n_inits = 5,
  Seed = NULL,
  parallel = FALSE,
  pca_plot = FALSE,
  covariance_type = "full",
  fixed_variance = FALSE,
```

```

cluster_specific_covariance = TRUE,
variance_prior_type = c("IW", "decomposed", "sparse", "off-diagonal normal"),
...
)

```

## Arguments

|                                          |                                                                                                                                                                                                                                                                                                                                                                                      |
|------------------------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>X</code>                           | input data as a matrix                                                                                                                                                                                                                                                                                                                                                               |
| <code>variational_params</code>          | number of clusters in the variational distribution                                                                                                                                                                                                                                                                                                                                   |
| <code>prior_shape_alpha</code>           | shape parameter of Gamma prior for the DP concentration parameter alpha. Default is 0.001                                                                                                                                                                                                                                                                                            |
| <code>prior_rate_alpha</code>            | rate parameter of Gamma prior for the DP concentration parameter alpha. Default is 0.001                                                                                                                                                                                                                                                                                             |
| <code>post_shape_alpha</code>            | initial value for posterior update of shape parameter for alpha. Default is 0.001                                                                                                                                                                                                                                                                                                    |
| <code>post_rate_alpha</code>             | initial value for posterior update of rate parameter for alpha. Default is 0.001                                                                                                                                                                                                                                                                                                     |
| <code>prior_mean_eta</code>              | mean vector of MVN prior for the DP mean parameters. Default is zero vector                                                                                                                                                                                                                                                                                                          |
| <code>post_mean_eta</code>               | initial value of posterior update for the DP mean parameter                                                                                                                                                                                                                                                                                                                          |
| <code>log_prob_matrix</code>             | logarithm of cluster allocation probability matrix. Default is NULL                                                                                                                                                                                                                                                                                                                  |
| <code>maxit</code>                       | maximum number of iterations. Default is 100                                                                                                                                                                                                                                                                                                                                         |
| <code>n_inits</code>                     | Number of random initialisations if <code>log_prob_matrix</code> and other case-specific hyperparameters are NULL. Default is 5                                                                                                                                                                                                                                                      |
| <code>Seed</code>                        | Seeds for random initialisation; either a vector of <code>n_inits</code> integers or NULL. Default is NULL.                                                                                                                                                                                                                                                                          |
| <code>parallel</code>                    | Logical input for parallelisation. Default is FALSE                                                                                                                                                                                                                                                                                                                                  |
| <code>pca_plot</code>                    | Logical input for pca plot. Default is FALSE                                                                                                                                                                                                                                                                                                                                         |
| <code>covariance_type</code>             | covariance matrix is considered diagonal or full. Default is 'full'                                                                                                                                                                                                                                                                                                                  |
| <code>fixed_variance</code>              | covariance matrix of the data is considered known (fixed) or unknown. Default is FALSE                                                                                                                                                                                                                                                                                               |
| <code>cluster_specific_covariance</code> | covariance matrix is specific to a cluster allocation or it is same over all cluster choices. Default is TRUE                                                                                                                                                                                                                                                                        |
| <code>variance_prior_type</code>         | For unknown and full covariance matrix, choice of matrix prior is either Inverse-Wishart ('IW') or Cholesky-decomposed ('decomposed'). For unknown, full and cluster-specific covariance matrix, choice of matrix prior is either Inverse-Wishart ('IW'), element-wise Gamma and Laplace distributed ('sparse') or element-wise Gamma and Normal distributed ('off-diagonal normal') |
| <code>...</code>                         | additional parameters, further details given below                                                                                                                                                                                                                                                                                                                                   |

## Details

The following models are supported in vimixr, listing their required input arguments in . . . when calling `cvi_npmmm()`:

- **Known covariance**

- *diagonal covariance* We need the following additional arguments:

**cov\_data: a non-negative diagonal matrix, representing the covariance of the data**

**prior\_precision\_scalar\_eta: a non-negative scalar, representing the precision prior for the DP mean parameters**

**post\_precision\_scalar\_eta: initial value for the posterior update of precision for the DP mean parameters**

- *full covariance* We need the following additional arguments:

**cov\_data: a positive definite matrix, representing the covariance of the data**

**prior\_cov\_eta: a positive definite matrix, representing the covariance prior for the DP mean parameters**

**post\_cov\_eta: initial value for the posterior update of covariance for the DP mean parameters**

- **Unknown covariance (Global)**

- *diagonal covariance* We need the following additional arguments:

**prior\_shape\_scalar\_cov: a non-negative scalar, representing the shape parameter of Gamma prior for the precision**

**prior\_rate\_scalar\_cov: a non-negative scalar, representing the rate parameter of Gamma prior for the precision**

**post\_shape\_scalar\_cov: initial value for posterior update of precision shape parameter**

**post\_rate\_scalar\_cov: initial value for posterior update of precision rate parameter**

**prior\_precision\_scalar\_eta: a non-negative scalar, representing the precision prior for the DP mean parameters**

**post\_precision\_scalar\_eta: initial value for the posterior update of precision for the DP mean parameters**

- *Inverse-Wishart* We need the following additional arguments:

**prior\_df\_cov: a scalar as the degree of freedom parameter of the Inverse-Wishart prior, Default value D+2**

**prior\_scale\_cov: positive-definite matrix as the scale parameter of the Inverse-Wishart prior**

**post\_df\_cov: initial value for the posterior update of degree of freedom**

**post\_scale\_cov: initial value for the posterior update of scale matrix**

**prior\_cov\_eta: a positive definite matrix, representing the covariance prior for the DP mean parameters**

**post\_cov\_eta: initial value for the posterior update of covariance for the DP mean parameters**

- *Cholesky-decomposition* We need the following additional arguments:

**prior\_shape\_diag\_decomp:** a non-negative scalar as the shape parameter of Gamma prior for diagonal elements

**prior\_rate\_diag\_decomp:** a non-negative scalar as the rate parameter of Gamma prior for diagonal elements

**prior\_mean\_offdiag\_decomp:** a scalar as the mean parameter of Normal prior for off-diagonal elements

**prior\_var\_offdiag\_decomp:** a non-negative scalar as the variance parameter of Normal prior for off-diagonal elements

**post\_shape\_diag\_decomp:** initial value for posterior update of the shape parameter for diagonal elements

**post\_rate\_diag\_decomp:** initial value for posterior update of the rate parameter for diagonal elements

**post\_mean\_offdiag\_decomp:** initial value for posterior update of the mean parameter for off-diagonal elements

**post\_var\_offdiag\_decomp:** initial value for posterior update of the variance parameter for off-diagonal elements

**prior\_cov\_eta:** a positive definite matrix, representing the covariance prior for the DP mean parameters

**post\_cov\_eta:** initial value for the posterior update of covariance for the DP mean parameters

- **Unknown covariance (cluster-specific)**

- *Inverse Wishart* We need the following additional arguments:

- prior\_df\_cs\_cov:** a vector representing degree of freedom parameters for each cluster-specific Inverse-Wishart

- prior\_scale\_cs\_cov:** an array of positive-definite matrices representing scale matrix parameters for each cluster

- post\_df\_cs\_cov:** initial value for posterior update of the degree of freedom parameters

- post\_scale\_cs\_cov:** initial value for posterior update of the scale matrix parameters

- scaling\_cov\_eta:** a non-negative scaling factor for covariance matrix of the DP mean parameters

- *Element-wise Gamma and Laplace prior* We need the following additional arguments:

- prior\_shape\_d\_cs\_cov:** a non-negative vector as shape parameters for cluster-specific Gamma priors of the diagonal elements

- prior\_rate\_d\_cs\_cov:** a non-negative matrix as rate parameter for cluster-specific Gamma prior of the diagonal elements

- prior\_var\_offd\_cs\_cov:** a non-negative vector as variance parameter for cluster-specific Laplace priors of the off-diagonal elements

- post\_shape\_d\_cs\_cov:** initial value for posterior update of the diagonal shape parameters

- post\_rate\_d\_cs\_cov:** initial value for posterior update of the diagonal rate parameters

- post\_var\_offd\_cs\_cov:** initial value for sum, squared sum and log sum of the off-diagonal variance parameters

scaling\_cov\_eta: a non-negative scaling factor for covariance matrix of the DP mean parameters

– *Element-wise Gamma and Normal prior* We need the following additional arguments:

prior\_shape\_d\_cs\_cov: a non-negative vector as shape parameters for cluster-specific Gamma priors of the

prior\_rate\_d\_cs\_cov: a non-negative matrix as rate parameter for cluster-specific Gamma prior of the di

prior\_var\_offd\_cs\_cov: a non-negative scalar as variance parameter for cluster-specific Normal priors of

post\_shape\_d\_cs\_cov: initial value for posterior update of the diagonal shape parameters

post\_rate\_d\_cs\_cov: initial value for posterior update of the diagonal rate parameters

post\_mean\_offd\_cs\_cov: initial value for posterior update of the off-diagonal mean parameters

scaling\_cov\_eta: a non-negative scaling factor for covariance matrix of the DP mean parameters

## Value

[vimixr()] returns a list with the following elements:

- alpha: posterior DP concentration parameter
- Cluster number: number of clusters from posterior probability allocation matrix
- Cluster Proportion: cluster proportions from posterior probability allocation matrix
- log Probability matrix: log of posterior probability allocation matrix
- ELBO: Optimisation of the ELBO function
- Iterations: Number of iterations required for convergence
- PCA\_viz: A PCA [ggplot2] plot to visualize the clustering of data based on cluster labels
- ELBO\_viz: A line [ggplot2] plot to visualize the ELBO optimisation

## Examples

```
X <- rbind(matrix(rnorm(100, m=0, sd=0.5), ncol=2),
            matrix(rnorm(100, m=3, sd=0.5), ncol=2))

#for fixed-diagonal
res <- cvi_npm(X, variational_params = 20, prior_shape_alpha = 0.001,
               prior_rate_alpha = 0.001, post_shape_alpha = 0.001,
               post_rate_alpha = 0.001, prior_mean_eta = matrix(0, 1, ncol(X)),
               post_mean_eta = matrix(0.001, 20, ncol(X)),
               log_prob_matrix = t(apply(matrix(-3, nrow(X), 20), 1,
                                           function(x){x/sum(x)})), maxit = 100,
               fixed_variance = TRUE, covariance_type = "diagonal",
               prior_precision_scalar_eta = 0.001,
               post_precision_scalar_eta = matrix(0.001, 20, 1),
               cov_data = diag(ncol(X)))
summary(res)
```

```
plot(res)
```

---

|                     |                                             |
|---------------------|---------------------------------------------|
| CVI_update_function | <i>Update of the variational parameters</i> |
|---------------------|---------------------------------------------|

---

## Description

Update of the variational parameters

## Usage

```
CVI_update_function(
  fixed_variance = FALSE,
  covariance_type = "diagonal",
  cluster_specific_covariance = TRUE,
  variance_prior_type = c("IW", "decomposed", "sparse", "off-diagonal normal"),
  X,
  inverts,
  params
)
```

## Arguments

|                                          |                                                                                                                                                                                                                                                                                                    |
|------------------------------------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <code>fixed_variance</code>              | whether the covariance is fixed or estimated. Default is FALSE which means it is estimated.                                                                                                                                                                                                        |
| <code>covariance_type</code>             | The assumed type of the covariance matrix. Can be either "diagonal" if it is the identify multiplied by a scalar, or "full" for a fully unspecified covariance matrix.                                                                                                                             |
| <code>cluster_specific_covariance</code> | whether the the covariance is shared across estimated clusters or is cluster specific. Default is TRUE which means it is cluster specific.                                                                                                                                                         |
| <code>variance_prior_type</code>         | character string specifying the type of prior distribution for the covariance when <code>cluster_specific_covariance</code> is TRUE. Can be either "IW" or "decomposed" if <code>cluster_specific_covariance</code> is FALSE, and can be either "IW", "sparse" or "off-diagonal normal" otherwise. |
| <code>X</code>                           | the data matrix                                                                                                                                                                                                                                                                                    |
| <code>inverts</code>                     | a list of inverses                                                                                                                                                                                                                                                                                 |
| <code>params</code>                      | a list of required arguments                                                                                                                                                                                                                                                                       |

## Value

Updated parameters

---

|      |                                             |
|------|---------------------------------------------|
| eBa0 | Root for a0 hyper-parameter for Sparse DPMM |
|------|---------------------------------------------|

---

**Description**

Root for a0 hyper-parameter for Sparse DPMM

**Usage**

```
eBa0(  
  logP,  
  X,  
  a_min = min(1e-08, 1/ncol(X)),  
  a_max = max(1e+06, ncol(X)),  
  grid_points = min(ncol(X), 10000)  
)
```

**Arguments**

|             |                                      |
|-------------|--------------------------------------|
| logP        | log of probability allocation matrix |
| X           | observed data                        |
| a_min       | minimum value of a0 for grid search  |
| a_max       | maximum value of a0 for grid search  |
| grid_points | number of points for grid search     |

**Value**

No return value, called for side effects.

---

|                     |                                                                             |
|---------------------|-----------------------------------------------------------------------------|
| elbo_fixed_diagonal | ELBO calculating functions depending on type of model for covariance matrix |
|---------------------|-----------------------------------------------------------------------------|

---

**Description**

ELBO calculating functions depending on type of model for covariance matrix

**Usage**

```
elbo_fixed_diagonal(X, inverts, params)
```

**Arguments**

|         |                              |
|---------|------------------------------|
| X       | the data matrix              |
| inverts | a list of inverses           |
| params  | a list of required arguments |

**Value**

No return value, called for side effects.

---

|               |                              |
|---------------|------------------------------|
| ELBO_function | <i>General ELBO function</i> |
|---------------|------------------------------|

---

**Description**

General ELBO function

**Usage**

```
ELBO_function(  
  fixed_variance = FALSE,  
  covariance_type = "diagonal",  
  cluster_specific_covariance = TRUE,  
  variance_prior_type = c("IW", "decomposed", "sparse", "off-diagonal normal"),  
  X,  
  inverts,  
  params  
)
```

**Arguments**

- `fixed_variance` whether the covariance is fixed or estimated. Default is FALSE which means it is estimated.
- `covariance_type` The assumed type of the covariance matrix. Can be either "diagonal" if it is the identify multiplied by a scalar, or "full" for a fully unspecified covariance matrix.
- `cluster_specific_covariance` whether the the covariance is shared across estimated clusters or is cluster specific. Default is TRUE which means it is cluster specific.
- `variance_prior_type` character string specifying the type of prior distribution for the covariance when `cluster_specific_covariance` is TRUE. Can be either "IW" or "decomposed" if `cluster_specific_covariance` is FALSE, and can be either "IW", "sparse" or "off-diagonal normal" otherwise.
- `X` the data matrix
- `inverts` a list of inverses
- `params` a list of required arguments

**Value**

ELBO values

---

|                   |                                                               |
|-------------------|---------------------------------------------------------------|
| generate_log_prob | <i>Generate random log Probability matrix if not provided</i> |
|-------------------|---------------------------------------------------------------|

---

**Description**

Generate random log Probability matrix if not provided

**Usage**

```
generate_log_prob(N, T0, seed0)
```

**Arguments**

|       |                                            |
|-------|--------------------------------------------|
| N     | rows of the data matrix                    |
| T0    | variational clusters                       |
| seed0 | seed for generating log Probability matrix |

**Value**

No return value, called for side effects.

---

|             |                                                                                 |
|-------------|---------------------------------------------------------------------------------|
| log_sum_exp | <i>Log-sum-exponential computation on the log probability allocation matrix</i> |
|-------------|---------------------------------------------------------------------------------|

---

**Description**

Log-sum-exponential computation on the log probability allocation matrix

**Usage**

```
log_sum_exp(Plog)
```

**Arguments**

|      |                                   |
|------|-----------------------------------|
| Plog | log probability allocation matrix |
|------|-----------------------------------|

**Value**

per sample ordered log probability allocation matrix

---

|                 |                        |
|-----------------|------------------------|
| lower_tri_stats | <i>lower_tri_stats</i> |
|-----------------|------------------------|

---

**Description**

Extract lower diagonal elements of a Matrix, and perform sum, squared sum and log sum

**Usage**

lower\_tri\_stats(M)

**Arguments**

M                      matrix

**Value**

a vector of sum, squared sum and log sum elements

---

|          |                 |
|----------|-----------------|
| mat_mult | <i>mat_mult</i> |
|----------|-----------------|

---

**Description**

Calculate matrix multiplication with optional transposition.

**Usage**

mat\_mult(A, B, transpose\_A = FALSE, transpose\_B = FALSE)

**Arguments**

A                      matrix or vector  
B                      matrix or vector  
transpose\_A          transpose A before multiplying  
transpose\_B          transpose B before multiplying

**Value**

A %\*% B (or variant), as vector if either input was a vector

---

|            |                   |
|------------|-------------------|
| mat_mult_t | <i>mat_mult_t</i> |
|------------|-------------------|

---

**Description**

Calculate a combination of matrix multiplications

**Usage**

```
mat_mult_t(A, B, C)
```

**Arguments**

|   |        |
|---|--------|
| A | matrix |
| B | matrix |
| C | matrix |

**Value**

```
A %% B %% t(C)
```

---

|              |                                                              |
|--------------|--------------------------------------------------------------|
| params_check | <i>Function to check the list of type-specific arguments</i> |
|--------------|--------------------------------------------------------------|

---

**Description**

Function to check the list of type-specific arguments

**Usage**

```
params_check(
  params,
  fixed_variance = FALSE,
  covariance_type = "diagonal",
  cluster_specific_covariance = TRUE,
  variance_prior_type = c("IW", "decomposed", "sparse", "off-diagonal normal")
)
```

**Arguments**

params                the list of required parameters  
 fixed\_variance       whether covariance is assumed fixed or not; can be TRUE or FALSE  
 covariance\_type       structure of covariance matrix; can be "diagonal" or "full"  
 cluster\_specific\_covariance       whether covariance matrix is cluster specific or not; can be TRUE or FALSE  
 variance\_prior\_type       prior distribution for the covariance matrix; can be "IW" or "decomposed" when cluster\_specific\_covariance = FALSE, or can be "IW", "sparse" or "off-diagonal normal" otherwise

**Value**

stops the code if the required list of arguments are not present

---

|                |                                                   |
|----------------|---------------------------------------------------|
| plot.CVIoutput | <i>S3 plotting function for CVIoutputobjects'</i> |
|----------------|---------------------------------------------------|

---

**Description**

S3 plotting function for CVIoutputobjects'

**Usage**

```
## S3 method for class 'CVIoutput'
plot(x, ...)
```

**Arguments**

x                      a CVIoutput object  
 ...                    additional arguments

**Value**

A ggplot object representing visualisation

---

|                     |                            |
|---------------------|----------------------------|
| quadratic_form_diag | <i>quadratic_form_diag</i> |
|---------------------|----------------------------|

---

**Description**

Calculate a combination of matrix multiplications

**Usage**

quadratic\_form\_diag(A, B)

**Arguments**

|   |        |
|---|--------|
| A | matrix |
| B | matrix |

**Value**

diag(A %% B %% t(A))

---

|            |                                                             |
|------------|-------------------------------------------------------------|
| run_single | <i>CVI implementation for one set of initial parameters</i> |
|------------|-------------------------------------------------------------|

---

**Description**

CVI implementation for one set of initial parameters

**Usage**

```
run_single(  
  config,  
  X,  
  N,  
  D,  
  T0,  
  prior_shape_alpha,  
  prior_rate_alpha,  
  post_shape_alpha,  
  post_rate_alpha,  
  prior_mean_eta,  
  post_mean_eta,  
  fixed_variance,  
  covariance_type,  
  cluster_specific_covariance,  
  variance_prior_type,
```

```

    maxit,
    varargs
)

```

### Arguments

|                             |                                                                                                                                                                                                                                                                                                                                                                                      |
|-----------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| config                      | List of inputs that are generated if not user-provided                                                                                                                                                                                                                                                                                                                               |
| X                           | the data matrix                                                                                                                                                                                                                                                                                                                                                                      |
| N                           | samples of X                                                                                                                                                                                                                                                                                                                                                                         |
| D                           | dimensions of X                                                                                                                                                                                                                                                                                                                                                                      |
| T0                          | variational clusters                                                                                                                                                                                                                                                                                                                                                                 |
| prior_shape_alpha           | shape parameter of Gamma prior for the DP concentration parameter alpha. Default is 0.001                                                                                                                                                                                                                                                                                            |
| prior_rate_alpha            | rate parameter of Gamma prior for the DP concentration parameter alpha. Default is 0.001                                                                                                                                                                                                                                                                                             |
| post_shape_alpha            | initial value for posterior update of shape parameter for alpha. Default is 0.001                                                                                                                                                                                                                                                                                                    |
| post_rate_alpha             | initial value for posterior update of rate parameter for alpha. Default is 0.001                                                                                                                                                                                                                                                                                                     |
| prior_mean_eta              | mean vector of MVN prior for the DP mean parameters. Default is zero vector                                                                                                                                                                                                                                                                                                          |
| post_mean_eta               | initial value of posterior update for the DP mean parameter                                                                                                                                                                                                                                                                                                                          |
| fixed_variance              | covariance matrix of the data is considered known (fixed) or unknown.                                                                                                                                                                                                                                                                                                                |
| covariance_type             | covariance matrix is considered diagonal or full.                                                                                                                                                                                                                                                                                                                                    |
| cluster_specific_covariance | covariance matrix is specific to a cluster allocation or it is same over all cluster choices.                                                                                                                                                                                                                                                                                        |
| variance_prior_type         | For unknown and full covariance matrix, choice of matrix prior is either Inverse-Wishart ('IW') or Cholesky-decomposed ('decomposed'). For unknown, full and cluster-specific covariance matrix, choice of matrix prior is either Inverse-Wishart ('IW'), element-wise Gamma and Laplace distributed ('sparse') or element-wise Gamma and Normal distributed ('off-diagonal normal') |
| maxit                       | Maximum number of iterations for variational updates                                                                                                                                                                                                                                                                                                                                 |
| varargs                     | List of case specific parameters                                                                                                                                                                                                                                                                                                                                                     |

### Value

a list with the following elements:

- alpha: posterior DP concentration parameter
- Cluster number: number of clusters from posterior probability allocation matrix
- Cluster Proportion: cluster proportions from posterior probability allocation matrix

- log Probability matrix: log of posterior probability allocation matrix
- ELBO: Optimisation of the ELBO function
- Iterations: Number of iterations required for convergence

---

|               |                      |
|---------------|----------------------|
| sparse_cov_op | <i>sparse_cov_op</i> |
|---------------|----------------------|

---

**Description**

Calculate the sum, squared sum and log sum of off-diagonal vector elements from the covariance array

**Usage**

sparse\_cov\_op(X, P, inv\_C0, L1)

**Arguments**

|        |                                                                          |
|--------|--------------------------------------------------------------------------|
| X      | data matrix                                                              |
| P      | probability allocation matrix                                            |
| inv_C0 | matrix corresponding diagonal elements of the cluster precision matrices |
| L1     | cluster mean matrix                                                      |

**Value**

likelihood term calculation in elbo

---

|          |                 |
|----------|-----------------|
| sweep_3D | <i>sweep_3D</i> |
|----------|-----------------|

---

**Description**

A C++ alternative of sweep() function from base R

**Usage**

sweep\_3D(A, R, dims, n\_threads = 4L)

**Arguments**

|           |                   |
|-----------|-------------------|
| A         | a 3D array        |
| R         | a vector          |
| dims      | dimensions in 3D  |
| n_threads | number of threads |

**Value**

sweep(A, 3, R, "\*")

---

|            |                   |
|------------|-------------------|
| t_mat_mult | <i>t_mat_mult</i> |
|------------|-------------------|

---

**Description**

Calculate a combination of matrix multiplications

**Usage**

t\_mat\_mult(A, B, C)

**Arguments**

- A                   matrix
- B                   matrix
- C                   matrix

**Value**

t(A) %% B %% C

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