Package 'NestMRMC'

May 7, 2026

Title Single Reader Between-Cases AUC Estimator in Nested Data

Version 1.0

Description This R package provides a calculation of between-cases AUC estimate, corresponding covariance, and variance estimate in the nested data problem. Also, the package has the function to simulate the nested data. The calculated between-cases AUC estimate is used to evaluate the reader's diagnostic performance in clinical tasks with nested data. For more details on the above methods, please refer to the paper by H Du, S Wen, Y Guo, F Jin, BD Gallas (2022) <doi:10.1177/09622802221111539>.

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Encoding UTF-8

LazyData true

RoxygenNote 7.2.1

Imports magrittr, dplyr, mvtnorm, iMRMC, Rcpp

LinkingTo Rcpp

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NeedsCompilation yes

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Contents

`AUC_cov_2reader_nest` *Function for calculating 2 reader AUC covariance*

Description

Function for calculating 2 reader AUC covariance

Usage

```
AUC_cov_2reader_nest(success_score)
```

Arguments

`success_score`	The success score for nested data

Value

the covariance between two readers' AUC

`AUC_per_reader_nest` *MRMC analysis in nested data problem*

Description

This function takes nested data as a data frame and runs a multi-reader multi-case analysis for single reader in nested data problem based on modified U-statistics as described in the following paper:

Usage

```
AUC_per_reader_nest(data)
```

Arguments

`data`	The nested data for analysis. This dataset should have specified columns: "patient","reader1","reader2","reader3","reader4","reader5","truth","mod","region".

Value

This function returns a list containing three dataframes.

```
Here is a quick summary:

 AUC_per_reader [data.frame] this data frame contains the AUC estimates for each reader under diffe

 AUC_Var_per_reader [data.frame] this data frame contains the AUC variance estimates for each reade

 numROI [data.frame] this data frame contains the number of positive and negative ROIs in each case.
```

Examples

```
data = NestMRMC::expected_data

Outputs = AUC_per_reader_nest(data)
```

`cov_m8_f1` *covariance 8th moment middle calculation part one*

Description

covariance 8th moment middle calculation part one

Usage

```
cov_m8_f1(m)
```

Arguments

`m`	input matrix

Value

the middle values for calculating covariance 8th moment

cov_m8_f2 *covariance 8th moment middle calculation part two*

Description

covariance 8th moment middle calculation part two

Usage

```
cov_m8_f2(m)
```

Arguments

m	input matrix

Value

the middle values for calculating covariance 8th moment

data_MRMC *Simulation function*

Description

Simulation function

Usage

```
data_MRMC(sim.config)
```

Arguments

sim.config	list contains following parameters: I num The number of patients. k num The number of ROIs in each patient. R num The number of readers. correlation_t num The correlation for simulating truth label. potential_correlation_s num The correlation for simulating reading scores. AUC_all num The theoretical AUC values. sameclustersize boolean The binary variable to decide whether we have same number of ROIs in each patient. rho num The scale parameter that infulence the covariance matrix in multivariate normal distribution. fix_design boolean Binary variable to decide whether fix the truth label in simulation. stream num The integer control the random number generator.

Value

A list and the only element in the list is the simulated data with following columns: "clusterID","unitID","reader1",...,"truth"

delete_diag *Delete diagonal term function*

Description

Delete diagonal term function

Usage

```
delete_diag(m)
```

Arguments

m	the input matrix for deleting diagonal term

Value

diagonal term removed matrix

expected_data *The test demo data to be included in my package*

Description

The test demo data to be included in my package

Author(s)

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m11_f *function for calculating the 11th moment*

Description

function for calculating the 11th moment

Usage

```
m11_f(m)
```

Arguments

m	input matrix

Value

the 11th moment

m8_f *function for calculating the 8th moment*

Description

function for calculating the 8th moment

Usage

```
m8_f(m)
```

Arguments

m	input matrix

Value

the 8th moment

simu_config *Configuration function*

Description

Configuration function

Usage

```
simu_config(
  I = 100,
  k = 10,
  R = 2,
  correlation_t = 0,
  potential_correlation_s = rep(0.5, 4),
  AUC_all = rep(0.7, 2),
  sameclustersize = TRUE,
  rho = 0.5,
  fix_design = FALSE,
  stream = 20220210,
  initial_seed = 20220222
)
```

Arguments

I	The number of patients.
k	The number of ROIs in each patient.
R	The number of readers.
correlation_t	The correlation for simulating truth label.
potential_correlation_s	The correlation for simulating reading scores.
AUC_all	The theoretical AUC values.
sameclustersize	The binary variable to decide whether we have same number of ROIs in each patient.
rho	The scale parameter that influence the covariance matrix in multivariate normal distribution.
fix_design	Binary variable to decide whether fix the truth label in simulation.
stream	The integer control the random number generator.
initial_seed	The integer control the random seed for truth label generation.

Value

A list of above parameters

---

success_score *Calculate the success score*

Description

Calculate the success score

Usage

```
success_score(data)
```

Arguments

data	the nested MRMC data

Value

The success score and number of ROIs in each case

sum_diag *sum the diagonal terms*

Description

sum the diagonal terms

Usage

```
sum_diag(m)
```

Arguments

m	input matrix

Value

sum of diagonal terms

true_AUC_var_abitrary *Calculate the between-cases AUC estimator's theoretical variance and covariance*

Description

This function calculates between-cases AUC estimator's theoretical variance and covariance based on all the truths, namely, the ROI's truth labels, AUC values, covariance between ROI scores within same reader, scale factor that influences the covariance between ROI scores between readers and the variances for positive and negative ROI scores. Detailed formulas are available in following paper: Single Reader Between-Cases AUC Estimator with Nested Data. Statistical Methods in Medical Research. https://doi.org/10.1177/09622802221111539. There is also a Rcpp version of this function in this package. The function name is 'true_AUC_var_abitrary_Rcpp', which is much faster than current version. They produce the exact same results.

Usage

```
true_AUC_var_abitrary(
  numROI,
  AUC = 0.7,
  cov = 0.5,
  rho = 0.5,
  sigma_pos = 1,
  sigma_neg = 1
)
```

Arguments

numROI	The number of positive and negative ROIs in all the patients.
AUC	The AUC values used in simulated data.
cov	The covariance used in simulating reading scores.
rho	The scale factor used in simulating reading scores.
sigma_pos	The variacne for positive ROI's reading score, defalut is 1.
sigma_neg	The variacne for negative ROI's reading score, defalut is 1.

Value

The theoretical AUC estimator's (co)variance based on the simulation settings.

---

true_AUC_var_abitrary_Rcpp

Calculate the between-cases AUC estimator's theoretical variance and covariance

---

Description

This function calculates between-cases AUC estimator's theoretical variance and covariance based on all the truths, namely, the ROI's truth labels, AUC values, covariance between ROI scores within same reader, scale factor that influences the covariance between ROI scores between readers and the variances for positive and negative ROI scores. Detailed formulas are available in following paper: Single Reader Between-Cases AUC Estimator with Nested Data. Statistical Methods in Medical Research. https://doi.org/10.1177/09622802221111539. There is also a none Rcpp version of this function in this package. The function name is 'true_AUC_var_abitrary', which is slower but no need to install Rcpp. They produce the exact same results.

Usage

```
true_AUC_var_abitrary_Rcpp(
  numROI,
  AUC = 0.7,
  cov = 0.5,
  rho = 0.5,
  sigma_pos = 1,
  sigma_neg = 1
)
```

Arguments

numROI	The number of positive and negative ROIs in all the patients.
AUC	The AUC values used in simulated data.
cov	The covariance used in simulating reading scores.
rho	The scale factor used in simulating reading scores.
sigma_pos	The variacne for positive ROI's reading score, defalut is 1.
sigma_neg	The variacne for negative ROI's reading score, defalut is 1.

Value

The theoretical AUC estimator's (co)variance based on the simulation settings.

`var_coef` *Calculate the each moments coefficient in variance*

Description

Calculate the each moments coefficient in variance

Usage

```
var_coef(numROI)
```

Arguments

`numROI`	number of ROIs in each case

Value

all the coefficients

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