

# Package: NestMRMC (via r-universe)

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**Title** Single Reader Between-Cases AUC Estimator with Nested Data

**Version** 1.0

**Description** This repository provide the R package for the methods in paper: Single Reader Between-Cases AUC Estimator with Nested Data. Statistical Methods in Medical Research. <https://doi.org/10.1177/09622802221111539>.

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**Repository** <https://didsr.r-universe.dev>

**RemoteUrl** <https://github.com/didsr/nestmrmc>

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AUC\_cov\_2reader\_nest    *Function for calculating 2 reader AUC covariance*

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### 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

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AUC\_per\_reader\_nest    *MRMC analysis in nested data problem*

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### 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 different conditions.

AUC\_Var\_per\_reader [data.frame] this data frame contains the AUC variance estimates for each reader under different conditions.

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

**Examples**

```
sim.config = simu_config()
data = data_MRMC(sim.config)$data_final
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

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cov_m8_f2	<i>covariance 8th moment middle calculation part two</i>
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**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

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data_MRMC	<i>Simulation function</i>
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**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 influence 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.
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**Value**

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

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delete_diag	<i>Delete diagonal term function</i>
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**Description**

Delete diagonal term function

**Usage**

delete\_diag(m)

**Arguments**

m                    the input matrix for deleting diagonal term

**Value**

diagonal term removed matrix

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m11_f	<i>function for calculating the 11th moment</i>
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**Description**

function for calculating the 11th moment

**Usage**

m11\_f(m)

**Arguments**

m                    input matrix

**Value**

the 11th moment

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m8_f	<i>function for calculating the 8th moment</i>
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---

**Description**

function for calculating the 8th moment

**Usage**

```
m8_f(m)
```

**Arguments**

m	input matrix
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**Value**

the 8th moment

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simu_config	<i>Configuration function</i>
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**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 = T,  
  rho = 0.5,  
  fix_design = F,  
  stream = 20220210  
)
```

**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.

**Value**

A list of above parameters

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success_score	<i>Calculate the success score</i>
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**Description**

Calculate the success score

**Usage**

```
success_score(data)
```

**Arguments**

data	the nested MRMC data
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**Value**

The success score and number of ROIs in each case

---

sum_diag	<i>sum the diagonal terms</i>
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**Description**

sum the diagonal terms

**Usage**

```
sum_diag(m)
```

**Arguments**

m                   input matrix

**Value**

sum of diagonal terms

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true_AUC_var_arbitrary	<i>Calculate the between-cases AUC estimator's theoretical variance and covariance</i>
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**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 Repp version of this function in this package. The function name is 'true\_AUC\_var\_arbitrary\_Repp', which is much faster than current version. They produce the exact same results.

**Usage**

```
true_AUC_var_arbitrary(  
  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 variance for positive ROI's reading score, default is 1.
sigma_neg	The variance for negative ROI's reading score, default is 1.

**Value**

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

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true\_AUC\_var\_arbitrary\_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\_arbitrary', which is slower but no need to install Rcpp. They produce the exact same results.

**Usage**

```
true_AUC_var_arbitrary_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 variance for positive ROI's reading score, default is 1.
sigma_neg	The variance for negative ROI's reading score, default is 1.

**Value**

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

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var\_coef

*Calculate the each moments coefficient in variance*

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**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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