

# Package ‘cgAUC’

May 8, 2026

**Type** Package

**Title** Calculate AUC-type measure when gold standard is continuous and the corresponding optimal linear combination of variables with respect to it.

**Version** 1.2.1

**Date** 2014-08-24

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**Description** The cgAUC can calculate the AUC-type measure of Obuchowski(2006) when gold standard is continuous, and find the optimal linear combination of variables with respect to this measure.

**License** GPL ( $\geq 2$ )

**Imports** Rcpp ( $\geq 0.11.2$ )

**LinkingTo** Rcpp

**NeedsCompilation** yes

**Repository** CRAN

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 cgAUC-package

*Calculate AUC when gold standard is continuous with large variables.*


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### Description

In this package, the cgAUC is used to calculate the AUC-type measure raised in Obuchowski(2006) when gold standard is continuous.

### Details

Package: cgAUC  
 Type: Package  
 Version: 1.2.1  
 Date: 2014-08-24  
 License: GPL (>=2)

### Author(s)

Yuan-chin I. Chang, Yu-chia Chang, and Ling-wan Chen  
 Maintainer: Yu-chia Chang <curare7177@gmail.com>

### References

Chang, YCI. Maximizing an ROC type measure via linear combination of markers when the gold reference is continuous. *Statistics in Medicine* 2012.  
 Obuchowski NA. An ROC-type measure of diagnostic accuracy when the gold standard is continuous-scale. *Statistics in Medicine* 2006; 25:481–493.  
 Obuchowski N. Estimating and comparing diagnostic tests accuracy when the gold standard is not binary. *Statistics in Medicine* 2005; 20:3261–3278.  
 Friedman JH, Popescu BE. Gradient directed regularization for linear regression and classification. Technical Report, Department of Statistics, Stanford University, 2004.

### Examples

```
# n = 100; p = 5;
# r.x = matrix(rnorm(n * p), , p) # raw data
# r.z = r.x[,1] + rnorm(n) # gold standard
# x = scale(r.x) # standardized of raw data
# z = scale(r.z) # standardized of gold standard
# h = n^(-1 / 2)
# t1 = cgAUC(r.x, r.z, h, delta = 1, auto = FALSE, tau = 1, scale = 1) # the delta be constant
# t1
# t2 = cgAUC(r.x, r.z, h, delta = 1, auto = TRUE, tau = 1, scale = 1) # the delta be variable
# t2
```

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cgAUC	<i>Calculate AUC when gold standard is continuous with large variables.</i>
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### Description

The cgAUC can calculate the AUC-type measure of Obuchowski(2006) when gold standard is continuous, and find the optimal linear combination of variables with respect to this measure.

### Usage

```
cgAUC(x, z, h, delta = 1, auto = FALSE, tau = 1, scale = 1)
```

### Arguments

x	The potential variables. It is a matrix with column of values of a variables. It should be standardized in this application.
z	The gold standard variable. It should be standardized.
h	The parameter controls the window width of smoothing function.
delta	The parameter be used in TGDM. The default value is one.
auto	Find the optimal delta in TGDM using cross-validation. If the auto is TRUE. The default is FALSE.
tau	The parameter used in TGDM. The default value is one.
scale	Scaling data when scale = 1, no scaling data when scale = 0. The default value is 1.

### Details

In this package, we use the TGDM to find the optimal linear combination of variables in order to maximize the AUC-type measure. Before using this function, all of variables, including gold standard variable, should be standardized first. Below are parameters used in the algorithm:

### Value

Rev	When Rev = 0 means $1 * 1$ ; otherwise, $1 * -1$ .
l	The estimate of coefficients for the optimal linear combination of variables.
theta.sh.h.p	The estimate of the theta of Chang(2012) for the optimal linear combination of variables.
theta.sh.h.p.var	The estimate of variance for the theta of Chang(2012).
cntin.ri	The estimate of the theta of Chang(2012) for each single variable.
theta.h.p	The estimate of the theta of Obuchowski(2006) for the optimal linear combination of variables.
theta.h.p.var	The estimate of variance for the theta of Obuchowski(2006).
dscrt.ri	The estimate of the theta of Obuchowski(2006) for each single variable.
delta	The value of delta.

**Author(s)**

Yu-chia Chang

**References**

Chang, YCI. Maximizing an ROC type measure via linear combination of markers when the gold reference is continuous. *Statistics in Medicine* 2012.

Obuchowski NA. An ROC-type measure of diagnostic accuracy when the gold standard is continuous-scale. *Statistics in Medicine* 2006; 25:481–493.

Obuchowski N. Estimating and comparing diagnostic tests accuracy when the gold standard is not binary. *Statistics in Medicine* 2005; 20:3261–3278.

Friedman JH, Popescu BE. Gradient directed regularization for linear regression and classification. Technical Report, Department of Statistics, Stanford University, 2004.

**Examples**

```
##---- Should be DIRECTLY executable !! ----
##-- ==> Define data, use random,
##--or do help(data=index) for the standard data sets.

# n = 100; p = 5;
# r.x = matrix(rnorm(n * p), , p) # raw data
# r.z = r.x[,1] + rnorm(n) # gold standard
# x = scale(r.x) # standardized of raw data
# z = scale(r.z) # standardized of gold standard
# h = n^(-1 / 2)
# t1 = cgAUC(r.x, r.z, h, delta = 1, auto = FALSE, tau = 1, scale = 1) # the delta be constant
# t1
# t2 = cgAUC(r.x, r.z, h, delta = 1, auto = TRUE, tau = 1, scale = 1) # the delta be variable
# t2

## The function is currently defined as
function(x, z, h, delta = 1, auto = FALSE, tau = 1)
{
  x = scale(x)
  z = scale(z)
  conv = FALSE
  n = dim(x)[1]
  p = dim(x)[2]
  cntin.ri = dscrt.ri = rep(0, p)
  id = diag(p)
  for (i in 1:p) {
    dscrt.ri[i] = dscrt(x, z, id[i, ])$theta.h.p
    cntin.ri[i] = cntin(x, z, id[i, ], h)$theta.sh.h.p
  }
  beta.i = ifelse(cntin.ri > 0.5, 1, -1)
  dscrt.ri = ifelse(dscrt.ri > 0.5, dscrt.ri, (1 - dscrt.ri))
  cntin.ri = ifelse(cntin.ri > 0.5, cntin.ri, (1 - cntin.ri))
  y = x * matrix(beta.i, n, p, byrow = TRUE)
  max.x = which(cntin.ri == max(cntin.ri))
}
```

```

theta.sh.h.p = 0
l = id[max.x, ]
while (conv == FALSE) {
d.l = d.theta.sh.h.p(y, z, l, h)
max.d.l = max(d.l)
ind.d.l = ifelse(d.l >= (tau * max.d.l), 1, 0) * d.l
if (auto == TRUE) {
delta = optimal.delta(y, z, l, h, ind.d.l)
}
l = l + delta * ind.d.l
l = l/max(l)
theta.temp = cntin(y, z, l, h)$theta.sh.h.p
ifelse(abs(theta.temp - theta.sh.h.p) < 1e-04, conv <- TRUE, conv <- FALSE)
theta.sh.h.p = theta.temp
}
optimal.dscrt = dscrt(y, z, l)
theta.sh.h.p.var = cntin(y, z, l, h)$var
l = l * beta.i
return(list(l = l, theta.sh.h.p = theta.sh.h.p, theta.sh.h.p.var = theta.sh.h.p.var,
cntin.ri = cntin.ri, theta.h.p = optimal.dscrt$theta.h.p,
theta.h.p.var = optimal.dscrt$var, dscrt.ri = dscrt.ri,
delta = delta))
}
## The function is currently defined as
function(x, z, h, delta = 1, auto = FALSE, tau = 1)
{
x = scale(x)
z = scale(z)
conv = FALSE
n = dim(x)[1]
p = dim(x)[2]
cntin.ri = dscrt.ri = rep(0, p)
id = diag(p)
for (i in 1:p) {
dscrt.ri[i] = dscrt(x, z, id[i, ])$theta.h.p
cntin.ri[i] = cntin(x, z, id[i, ], h)$theta.sh.h.p
}
beta.i = ifelse(cntin.ri > 0.5, 1, -1)
dscrt.ri = ifelse(dscrt.ri > 0.5, dscrt.ri, (1 - dscrt.ri))
cntin.ri = ifelse(cntin.ri > 0.5, cntin.ri, (1 - cntin.ri))
y = x * matrix(beta.i, n, p, byrow = TRUE)
max.x = which(cntin.ri == max(cntin.ri))
theta.sh.h.p = 0
l = id[max.x, ]
while (conv == FALSE) {
d.l = d.theta.sh.h.p(y, z, l, h)
max.d.l = max(d.l)
ind.d.l = ifelse(d.l >= (tau * max.d.l), 1, 0) * d.l
if (auto == TRUE) {
delta = optimal.delta(y, z, l, h, ind.d.l)
}
l = l + delta * ind.d.l
l = l/max(l)
}
}

```

```

    theta.temp = cntin(y, z, l, h)$theta.sh.h.p
    ifelse(abs(theta.temp - theta.sh.h.p) < 1e-04, conv <- TRUE,
           conv <- FALSE)
    theta.sh.h.p = theta.temp
  }
  optimal.dscrt = dscrt(y, z, l)
  theta.sh.h.p.var = cntin(y, z, l, h)$var
  l = l * beta.i
  return(list(l = l, theta.sh.h.p = theta.sh.h.p, theta.sh.h.p.var = theta.sh.h.p.var,
             cntin.ri = cntin.ri, theta.h.p = optimal.dscrt$theta.h.p,
             theta.h.p.var = optimal.dscrt$var, dscrt.ri = dscrt.ri,
             delta = delta))
}

```

---

c\_cntin

c\_cntin

---

### Description

Continue function, when variable was continue.

### Usage

```
c_cntin(y, z, l, h)
```

### Arguments

y	The potential variables. It is a matrix with column of values of a variables. It should be standardized in this application.
z	The gold standard variable. It should be standardized.
l	Linear combination. A vector.
h	The value of h falls into ( $n^{(-1/2)}$ , $n^{(-1/5)}$ ).

### Value

theta.sh.h.p	The estimate of the theta of Chang(2012).
var	The variance of estimate of the theta of Chang(2012).

### Author(s)

Yu-chia Chang

## References

- Chang, YCI. Maximizing an ROC type measure via linear combination of markers when the gold reference is continuous. *Statistics in Medicine* 2012.
- Obuchowski NA. An ROC-type measure of diagnostic accuracy when the gold standard is continuous-scale. *Statistics in Medicine* 2006; 25:481–493.
- Obuchowski N. Estimating and comparing diagnostic tests accuracy when the gold standard is not binary. *Statistics in Medicine* 2005; 20:3261–3278.
- Friedman JH, Popescu BE. Gradient directed regularization for linear regression and classification. Technical Report, Department of Statistics, Stanford University, 2004.

## Examples

```
##---- Should be DIRECTLY executable !! ----
##-- ==> Define data, use random,
##--or do help(data=index) for the standard data sets.

## The function is currently defined as
function(y, z, l, h) {
  .Call('cgAUC_c_cntin', PACKAGE = 'cgAUC', y, z, l, h)
}
```

---

c\_dscrt

*c\_dscrt*


---

## Description

discrete function, when variable is discrete.

## Usage

```
c_dscrt(y, z, l)
```

## Arguments

- |   |  |
|---|--|
| y | The potential variables. It is a matrix with column of values of a variables. It should be standardized in this application. |
| z | The gold standard variable. It should be standardized.   |
| l | Linear combination. A vector.  |

## Details

Discrete function, when variable is discrete.

## Value

- |           |  |
|-----------|--|
| theta.h.p | The estimate of theta when variable is discrete. |
| var       | The variance of estimate of theta.               |

**Author(s)**

Yu-chia Chang

**References**

Chang, YCI. Maximizing an ROC type measure via linear combination of markers when the gold reference is continuous. *Statistics in Medicine* 2012.

Obuchowski NA. An ROC-type measure of diagnostic accuracy when the gold standard is continuous-scale. *Statistics in Medicine* 2006; 25:481–493.

Obuchowski N. Estimating and comparing diagnostic tests accuracy when the gold standard is not binary. *Statistics in Medicine* 2005; 20:3261–3278.

Friedman JH, Popescu BE. Gradient directed regularization for linear regression and classification. Technical Report, Department of Statistics, Stanford University, 2004.

**Examples**

```
##---- Should be DIRECTLY executable !! ----
##-- ==> Define data, use random,
##--or do help(data=index) for the standard data sets.

## The function is currently defined as
function(y, z, l) {
  .Call('cgAUC_c_dscrt', PACKAGE = 'cgAUC', y, z, l)
}
```

---

c\_d\_theta\_sh\_h\_p      *c\_d\_theta\_sh\_h\_p*

---

**Description**

Compute the c\_d\_theta\_sh\_h\_p.

**Usage**

```
c_d_theta_sh_h_p(y, z, l, h)
```

**Arguments**

y	The potential variables. It is a matrix with column of values of a variables. It should be standardized in this application.
z	The gold standard variable. It should be standardized.
l	Linear combination. A vector.
h	The value of h falls into ( $n^{(-1/2)}$ , $n^{(-1/5)}$ ).

**Details**

Compute the c\_d\_theta\_sh\_h\_p Come from differential.

**Value**

d.theta.sh.h.p Theta after differential.

**Author(s)**

Yu-chia Chang

**References**

Chang, YCI. Maximizing an ROC type measure via linear combination of markers when the gold reference is continuous. *Statistics in Medicine* 2012.

Obuchowski NA. An ROC-type measure of diagnostic accuracy when the gold standard is continuous-scale. *Statistics in Medicine* 2006; 25:481–493.

Obuchowski N. Estimating and comparing diagnostic tests accuracy when the gold standard is not binary. *Statistics in Medicine* 2005; 20:3261–3278.

Friedman JH, Popescu BE. Gradient directed regularization for linear regression and classification. Technical Report, Department of Statistics, Stanford University, 2004.

**Examples**

```
##---- Should be DIRECTLY executable !! ----
##-- ==> Define data, use random,
##--or do help(data=index) for the standard data sets.

## The function is currently defined as
function(y, z, l, h) {
  .Call('cgAUC_c_d_theta_sh_h_p', PACKAGE = 'cgAUC', y, z, l, h)
}
```

---

c\_s\_h

*c\_s\_h*

---

**Description**

Smooth function.

**Usage**

c\_s\_h(t, h)

**Arguments**

t A value, the difference between any two subjects.

h The value of h falls into  $(n^{(-1/2)}, n^{(-1/5)})$ .

**Details**

Smooth function.

**Value**

s\_h                    The value of smooth function.

**Author(s)**

Yu-chia Chang

**References**

Chang, YCI. Maximizing an ROC type measure via linear combination of markers when the gold reference is continuous. *Statistics in Medicine* 2012.

Obuchowski NA. An ROC-type measure of diagnostic accuracy when the gold standard is continuous-scale. *Statistics in Medicine* 2006; 25:481–493.

Obuchowski N. Estimating and comparing diagnostic tests accuracy when the gold standard is not binary. *Statistics in Medicine* 2005; 20:3261–3278.

Friedman JH, Popescu BE. Gradient directed regularization for linear regression and classification. Technical Report, Department of Statistics, Stanford University, 2004.

**Examples**

```
##---- Should be DIRECTLY executable !! ----
##-- ==> Define data, use random,
##--or do help(data=index) for the standard data sets.

## The function is currently defined as
function(t, h) {
  .Call('cgAUC_c_s_h', PACKAGE = 'cgAUC', t, h)
}
```

---

optimal.delta

*optimal.delta*

---

**Description**

Find the optimal delta.

**Usage**

```
optimal.delta(y, z, l, h, ind.d.l)
```

**Arguments**

y	The potential variables. It is a matrix with column of values of a variables. It should be standardized in this application.
z	The gold standard variable. It should be standardized.
l	Linear combination. A vector.
h	The value of h falls into ( $n^{(-1/2)}$ , $n^{(-1/5)}$ ).
ind.d.l	Void

**Value**

delta.star      Optimal delta.

**Author(s)**

Yu-chia Chang

**References**

Chang, YCI. Maximizing an ROC type measure via linear combination of markers when the gold reference is continuous. *Statistics in Medicine* 2012.

Obuchowski NA. An ROC-type measure of diagnostic accuracy when the gold standard is continuous-scale. *Statistics in Medicine* 2006; 25:481–493.

Obuchowski N. Estimating and comparing diagnostic tests accuracy when the gold standard is not binary. *Statistics in Medicine* 2005; 20:3261–3278.

Friedman JH, Popescu BE. Gradient directed regularization for linear regression and classification. Technical Report, Department of Statistics, Stanford University, 2004.

**Examples**

```
##---- Should be DIRECTLY executable !! ----
##-- ==> Define data, use random,
##--or do help(data=index) for the standard data sets.

## The function is currently defined as
function (y, z, l, h, ind.d.l)
{
  l.i = matrix(rep(1, times = 50), nrow = 50, byrow = TRUE)
  delta = seq(0, 5, length = 50)
  m = delta %*% t(ind.d.l)
  l.i = l.i + m
  l.i.max = apply(l.i, 1, max)
  l.i = l.i/l.i.max
  theta = rep(0, 50)
  for (i in 2:50) {
    theta[i] = cntin(y, z, l.i[i, ], h)$theta.sh.h.p
  }
  delta.star = delta[which(theta == max(theta))]
  return(delta.star)
}
```

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