

# Package ‘HandTill2001’

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**Type** Package

**Title** Multiple Class Area under ROC Curve

**Version** 1.0.1

**Description** An S4 implementation of Eq. (3) and Eq. (7) by  
David J. Hand and Robert J. Till (2001) <[DOI:10.1023/A:1010920819831](https://doi.org/10.1023/A:1010920819831)>.

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**URL** <https://gitlab.com/fvafrCU/HandTill2001>

**Depends** R (>= 2.14)

**Imports** methods, utils

**Suggests** caTools, devtools, knitr, MASS, mda, nnet, pkgload,  
rmarkdown, ROCR, rpart, rprojroot, RUnit, testthat

**VignetteBuilder** utils

**RoxygenNote** 7.1.1

**NeedsCompilation** no

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HandTill2001-package *Multiple Class Area under ROC Curve*

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### Description

A very lean package implementing merely  $M$  given by *Hand and Till (2001)*, Eq. (7).

### Details

$M$  given by *Hand and Till (2001)* defines a multiple class version of the area under curve of the receiver operating characteristic.

### References

*David J. Hand and Robert J. Till (2001). A Simple Generalisation of the Area Under the ROC Curve for Multiple Class Classification Problems. Machine Learning 45(2), p. 171–186. DOI: 10.1023/A:1010920819831.*

### See Also

`help(package="HandTill2001")`, especially `?HandTill2001::auc`; various packages that calculate binary class AUC ([ROCR](#)) or multiple class AUC (pROC, [caTools](#)).

### Examples

```
library(HandTill2001)
data(ht01.multipleclass)
auc(
  multcap(
    response = ht01.multipleclass$observed,
    predicted = as.matrix(ht01.multipleclass[, levels(ht01.multipleclass$observed)])
  )
)
```

---

auc-methods

*Methods for Function auc in Package* **HandTill2001**

---

### Description

Calculate area under curve of the receiver operating characteristic for two or more prediction classes.

**Usage**

```
## S4 method for signature 'bincap'
auc(object)

## S4 method for signature 'multcap'
auc(object)
```

**Arguments**

object            An object of class *bincap* or *multcap*.

**Details**

Depending on whether object is of class *bincap* or of class *multcap*, a binary class or multiple class AUC is calculated.

**Value**

An object of class "numeric".

**Methods**

**signature(object = "bincap")** calculates the AUC statistic for a binary class response following *Hand and Till (2001)*, Eq. (3).

**signature(object = "multcap")** calculates the AUC statistic for a multiple class response following *Hand and Till (2001)*, Eq. (7).

**References**

*David J. Hand and Robert J. Till (2001). A Simple Generalisation of the Area Under the ROC Curve for Multiple Class Classification Problems. Machine Learning 45(2), p. 171–186. DOI: 10.1023/A:1010920819831.*

**See Also**

[class?bincap](#), [class?multcap](#)

**Examples**

```
data(ht01.twoclass, package = "HandTill2001")
message(" == AUC for a binary class response")
message(" == HandTill2001 result:")
HandTill2001::auc(HandTill2001::bincap(
  response = as.factor(ht01.twoclass[["observed"]]),
  predicted = ht01.twoclass[["predicted"]],
  true = "1"
))
## Not run:
message(" == ROCR result:")
ROCR::performance(ROCR::prediction(
```

```

    labels = ht01.twoclass[["observed"]],
    predictions = ht01.twoclass[["predicted"]]
  ),
  measure = "auc"
)@y.values

## End(Not run)
data(ht01.multipleclass, package = "HandTill2001")
message(" == AUC for a multiple class response")
predicted <- as.matrix(ht01.multipleclass[, levels(ht01.multipleclass[["observed"]])])
HandTill2001::auc(HandTill2001::multcap(
  response = ht01.multipleclass[["observed"]],
  predicted = predicted
))

```

---

bincap

*A Constructor for Objects of Class bincap*


---

## Description

bincap(...) is an alias to new("bincap", ...).

## Usage

```
bincap(response, predicted, true = "1")
```

## Arguments

response	Object of class factor.
predicted	Object of class numeric.
true	Object of class character.

## Details

There is no casting or conversion of data. bincap(...) is just an alias to new("bincap", ...).

## Value

An object of class bincap.

## See Also

[class?HandTill2001::bincap](#)

## Examples

```
library(HandTill2001)
data(ht01.twoclass)
str(ht01.twoclass$observed)
message("note that ht01.twoclass$observed is not a factor; we have to convert it.")
bincap(
  response = as.factor(ht01.twoclass$observed),
  predicted = ht01.twoclass$predicted,
  true = c("1")
)
```

---

bincap-class

*Binary Class and Prediction Objects*

---

## Description

S4 class for a binary class response and corresponding (predicted) probabilities.

## Objects from the Class

Objects can be created by calls of the form `new("bincap", ...)`. They are used to store a binary class response (one of the two levels of which is supposed to be true), the information which of the two levels of the binary class response is thought of as 'true'/'positive'/'present' (the other one would then be thought of as 'false'/'negative'/'absence') and the predicted probabilities that response is true.

## Note

No defaults are set. Especially, you have to explicitly initialize `true`, there is no trying to guess it from the levels of response.

## See Also

[class?HandTill2001::cap](#), [class?HandTill2001::multcap](#), [?HandTill2001::bincap](#)

## Examples

```
showClass("bincap")
```

---

ht01.multipleclass      *Example Data for Multiple Classes*

---

### Description

Multiple class data and probability predictions thereof.

### Format

A data frame with 214 observations on the following 7 variables.

**observed** a factor with levels Con Head Tabl Veh WinF WinNF

**WinF** a numeric vector

**WinNF** a numeric vector

**Veh** a numeric vector

**Con** a numeric vector

**Tabl** a numeric vector

**Head** a numeric vector

### Details

Multiple class data ('observed': MASS::fgl\$type) and probability predictions (predict(fgl.rp4), cf. Venables and Ripley (2002), p. 264 and 'Source') from rpart::rpart.

### Source

```
## From: Forensic glass example Venables and Ripley
(2002) pp. 261--265 library(MASS);library(rpart);data(fgl);set.seed(123)
fgl.rp4 <- rpart(type ~ ., data = fgl, cp = 0.03 , parms = list(split =
"information")) ht01.multipleclass <- data.frame(observed = fgl$type,
predict(fgl.rp4)) write.table(ht01.multipleclass, file =
"ht01.multipleclass.txt")
```

### References

Venables, W. N and Ripley, B. D. (2002), *Modern Applied Statistics with S* (4th edition). Springer, ISBN 0-387-95457-0

### Examples

```
library(HandTill2001)
data(ht01.multipleclass)
str(ht01.multipleclass)
```

---

`ht01.twoclass`*Example Data for Binary Classes*

---

**Description**

Binary class data and probability predictions thereof.

**Format**

A data frame with 189 observations on the following 2 variables.

**observed** a numeric vector

**predicted** a numeric vector

**Details**

Binary class data ('observed': MASS::birthwt\$low) and probability predictions (predict(birthwt.step2, type = "response"), cf. Venables and Ripley (2002), pp. 195f and 'Source') from stats::glm.

**Source**

```
## From: A binary class data example Venables and
Ripley pp. 194--199 library(MASS); data("birthwt"); attach(birthwt) race <-
(factor(race, labels = c("white", "black", "other"))) ptd <- factor(ptl > 0)
ftv <- factor(ftv) levels(ftv)[-1:2] <- "2+" bwt <- data.frame(low =
factor(low), age, lwt, race, smoke = (smoke > 0) , ptd, ht = (ht > 0), ui =
(ui > 0), ftv) detach(birthwt) birthwt.glm <- glm(low ~ .,
family=binomial(link=logit), data=bwt) birthwt.step2 <- stepAIC(birthwt.glm,
~ .^2 + I(scale(age)^2) + I(scale(lwt)^2), trace = F ) ht01.twoclass <-
data.frame(observed = bwt$low , predicted = predict(birthwt.step2 , type =
"response")) write.table(ht01.twoclass, file = "ht01.twoclass.txt")
```

**References**

Venables, W. N and Ripley, B. D. (2002), *Modern Applied Statistics with S* (4th edition). Springer, ISBN 0-387-95457-0

**Examples**

```
library(HandTill2001)
data(ht01.twoclass)
str(ht01.twoclass)
```

---

`multcap`*A Constructor for Objects of Class multcap*

---

**Description**

`multcap(...)` is an alias to `new("multcap", ...)`.

**Usage**

```
multcap(response, predicted)
```

**Arguments**

<code>response</code>	Object of class <code>factor</code> .
<code>predicted</code>	Object of class <code>matrix</code> .

**Details**

There is no casting or conversion of data. `multcap(...)` is just an alias to `new("multcap", ...)`.

**Value**

An object of class `multcap`.

**See Also**

[class?HandTill2001::multcap](#)

**Examples**

```
library(HandTill2001)
data(ht01.multipleclass)
str(ht01.multipleclass$observed)
message("note that ht01.multipleclass$observed is a factor; we do not have to convert it.")
multcap(
  response = ht01.multipleclass$observed,
  predicted = as.matrix(ht01.multipleclass[, levels(ht01.multipleclass$observed)])
)
```



---

`multcap-class`*Multiple Class and Prediction Objects*

---

**Description**

S4 class for a multiple class response and corresponding (predicted) probabilities.

**Objects from the Class**

Objects can be created by calls of the form `new("multcap", ...)`. They are used to store a multiple class response and the predicted probabilities for each of the `levels(response)`.

**See Also**

[class?HandTill2001::cap](#), [class?HandTill2001::bincap](#), [?HandTill2001::multcap](#)

**Examples**

```
showClass("multcap")
```

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