

# Package ‘r4lineups’

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**Title** Statistical Inference on Lineup Fairness

**Version** 0.1.1

**Maintainer** Colin Tredoux <colin.tredoux@uct.ac.za>

**Description** Since the early 1970s eyewitness testimony researchers have recognised the importance of estimating properties such as lineup bias (is the lineup biased against the suspect, leading to a rate of choosing higher than one would expect by chance?), and lineup size (how many reasonable choices are in fact available to the witness? A lineup is supposed to consist of a suspect and a number of additional members, or foils, whom a poor-quality witness might mistake for the perpetrator). Lineup measures are descriptive, in the first instance, but since the earliest articles in the literature researchers have recognised the importance of reasoning inferentially about them. This package contains functions to compute various properties of laboratory or police lineups, and is intended for use by researchers in forensic psychology and/or eyewitness testimony research. Among others, the r4lineups package includes functions for calculating lineup proportion, functional size, various estimates of effective size, diagnosticity ratio, homogeneity of the diagnosticity ratio, ROC curves for confidence x accuracy data and the degree of similarity of faces in a lineup.

**Depends** R (>= 3.4.0)

**Imports** boot, dplyr, ggplot2, ggrepel, here, magick, magrittr, pROC,  
psych, purrr, stats, utils

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**Author** Colin Tredoux [aut, cre],  
Tamsyn Naylor [aut]

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## Contents

allfoilbias . . . . .	3
allfoil_cihigh . . . . .	4
allprop . . . . .	4
chi_diag . . . . .	5
compare_eff_sizes.boot . . . . .	6
datacheck1 . . . . .	7
datacheck2 . . . . .	8
datacheck3 . . . . .	9
diag_param . . . . .	9
diag_ratio_T . . . . .	11
diag_ratio_W . . . . .	12
d_bar . . . . .	13
d_weights . . . . .	15
effsize_compare . . . . .	16
eff_size_per_foils . . . . .	18
esize_m . . . . .	18
esize_m_boot . . . . .	20
esize_T . . . . .	21
esize_T_boot . . . . .	22
esize_T_ci_n . . . . .	23
face_sim . . . . .	24
func_size . . . . .	24
func_size.boot . . . . .	25
func_size_report . . . . .	26
gen_boot_propci . . . . .	27
gen_boot_propmean_se . . . . .	28
gen_boot_samples . . . . .	29
gen_boot_samples_list . . . . .	30
gen_esize_m . . . . .	30
gen_esize_m_ci . . . . .	31
gen_lineup_prop . . . . .	32
gen_linevec . . . . .	33
homog_diag . . . . .	34
homog_diag_boot . . . . .	35
i_esize_T . . . . .	36
line73 . . . . .	37
lineup_boot_allprop . . . . .	38
lineup_prop_boot . . . . .	39
lineup_prop_tab . . . . .	40
lineup_prop_vec . . . . .	40
ln_diag_ratio . . . . .	41
makevec_prop . . . . .	43
make_roc . . . . .	43
make_rocdata . . . . .	44
mickwick . . . . .	45
mockdata . . . . .	45

<i>allfoilbias</i>	3
nortje2012 . . . . .	46
rep_index . . . . .	46
rot_vector . . . . .	47
show_lineup . . . . .	47
var_diag_ratio . . . . .	47
var_lnd . . . . .	48
<b>Index</b>	<b>51</b>

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<i>allfoilbias</i>	<i>Bias for each lineup member</i>
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### Description

Function to compute bias for each lineup member (assuming foil is suspect, from Malpass, 1981)

### Usage

```
allfoilbias(lineup_table, target_pos, k)
```

### Arguments

lineup_table	A table of lineup choices
target_pos	A scalar, representing target position in lineup. Must be declared by user
k	Nominal size (i.e., total number of members in lineup). Must be specified by user (scalar).

### References

Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.

### Examples

```
lineup_vec <- round(runif(100, 1, 6))
lineup_table <- table(lineup_vec)
x <- allfoilbias(lineup_table, 5, 6)
```

allfoil\_cihigh      *Confidence Intervals for Proportion*

---

**Description**

Function to compute ci high for each foil in a lineup

**Usage**

```
allfoil_cihigh(linetabprops, sumlineup)
```

**Arguments**

linetabprops      A dataframe of bootstrapped lineup proportions  
sumlineup          Number of members in a lineup

**References**

Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.

---

allprop              *Lineup proportion for all lineup members*

---

**Description**

Computes lineup proportion for each member in a lineup

**Usage**

```
allprop(lineup_vec, k)
```

**Arguments**

lineup\_vec          A numeric vector of lineup choices  
k                    Number of members in lineup. Must be specified by user (scalar).

**Value**

Returns a vector containing lineup proportion for each lineup member

**References**

Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

## Examples

```
#Data:
lineup_vec <- round(runif(100, 1, 6))

#Call:
x <- allprop(lineup_vec, k = 6)
```

---

chi\_diag

*Chi-squared estimate of homogeneity of diagnosticity ratio*

---

## Description

Function for getting chi-squared value for homogeneity of diagnosticity ratios

## Usage

```
chi_diag(df)
```

## Arguments

df                    A dataframe containing: ln(d), variance of ln(d), d weights

## Details

- To compute linedf, use the `diag_param` helper function.
- To compute df, apply `ln_diag_ratio`, `var_lnd` & `d_weights` functions to linedf, then bind results into one dataframe (see **Examples**)
- The order in which the estimates are bound together (i.e., their position in the dataframe) is important, and should always be as follows: row 1: *var*, row 2: *lnd*, row 3: *wi*.

## Value

Chi squared estimate of homogeneity of diagnosticity ratios for k independent lineups

## References

- Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.
- Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Tolia (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.
- Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.
- Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.
- Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

**Examples**

```

#Target present data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
C <- round(runif(20,1,4))
lineup_pres_list <- list(A, B, C)
rm(A, B, C)

#Target absent data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
C <- round(runif(20,1,4))
lineup_abs_list <- list(A, B, C)
rm(A, B, C)

#Pos list
lineup1_pos <- c(1, 2, 3, 4, 5, 6)
lineup2_pos <- c(1, 2, 3, 4, 5)
lineup3_pos <- c(1, 2, 3, 4)
pos_list <- list(lineup1_pos, lineup2_pos, lineup3_pos)
rm(lineup1_pos, lineup2_pos, lineup3_pos)

#Nominal size:
k <- c(6, 5, 4)

#Use diag param helper function to get data (n11, n21, n12, n22):
linedf <- diag_param(lineup_pres_list, lineup_abs_list, pos_list, k)

#Get ln(d), variance of ln(d) & d weights:
ratio <- ln_diag_ratio(linedf)
var <- var_lnd(linedf)
wi <- d_weights(linedf)

#Bind estimates into one df of 3 rows & x observations
#(see Details above)
df <- t(cbind(ratio, var, wi))

#Call:
chi_diag(df)

```

---

compare\_eff\_sizes.boot

*Comparing Effective Size: Base function for bootstrapping*

---

**Description**

A base function for bootstrapping a dataframe of choices for 2 independent lineups

**Usage**

```
compare_eff_sizes.boot(linedf, d)
```

**Arguments**

linedf	A dataframe of lineup data. Must consist of 2 columns, each containing data for 2 independent lineups
d	Indices for bootstrap sample. Argument used by boot function to select samples for bootstrapping

**Details**

The approach here is to compute the effective size of each lineup separately, and to take the difference between them. This is then bootstrapped, and if the bootstrap does not contain 0, we conclude the effective size estimates are different at  $p = \alpha$

**References**

- Davison, A.C. & Hinkley, D.V. (1997). *Bootstrap methods and their application*. Cambridge University Press.
- Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.
- Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Tolia (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.
- Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.
- Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.
- Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

---

 datacheck1

*Helper function*


---

**Description**

Checks that number of lineup choices contained in a vector is accurate

**Usage**

```
datacheck1(lineup_vec, k)
```

**Arguments**

lineup_vec	A numeric vector of lineup choices
k	Number of members in lineup

**Details**

This function ensures that a non-selected lineup member is not accidentally omitted from the dataframe due to lack of selection by all mock witnesses. It functions as a check that the total number of lineup members is accurate.

---

datacheck2	<i>Helper function</i>
------------	------------------------

---

**Description**

Checks that number of lineup choices contained in a vector is accurate

**Usage**

```
datacheck2(lineup_pres, lineup_abs, k1, k2)
```

**Arguments**

lineup_pres	A numeric vector of lineup choices for a lineup in which the target was present
lineup_abs	A numeric vector of lineup choices for a lineup in which the target was absent
k1	Number of targets in TP lineup
k2	Number of targets in TA lineup

**Details**

This function ensures that a non-selected lineup member is not accidentally omitted from the dataframe due to lack of selection by all mock witnesses. It functions as a check that the total number of lineup members is accurate



---

datacheck3	<i>Helper function</i>
------------	------------------------

---

**Description**

Checks that number of lineup choices contained in a data table is accurate

**Usage**

```
datacheck3(lineup_table, k)
```

**Arguments**

lineup_table	A table of lineup choices
k	Nominal size (i.e., total number of members in lineup)

**Details**

This function ensures that a non-selected lineup member is not accidentally omitted from the data due to lack of selection by all mock witnesses. It functions as a check that the total number of lineup members is accurate.

---

diag_param	<i>Parameters for diagnosticity ratio</i>
------------	---

---

**Description**

This function calculates the parameters needed to calculate the diagnosticity ratio for several lineup pairs.

**Usage**

```
diag_param(lineup_pres_list, lineup_abs_list, pos_list, k)
```

**Arguments**

lineup_pres_list	A list containing k vectors of lineup choices for k lineups, in which the target was present
lineup_abs_list	A list containing k vectors of lineup choices for k lineups, in which the target was absent
pos_list	A list containing k numeric vectors indexing lineup member positions for each lineup pair
k	A vector indexing number of members in each lineup pair. Must be specified by user (scalar).

## Details

- Lineup pairs consist of one lineup in which the target was present (TP) and one lineup in which the target was absent (TA).
- Each lineup pair must occupy corresponding positions in the TA and TP lists.  
Example:  
For a lineup pair A that consists of (1)TP lineup and (2)TA lineup: A(1) is the first vector in the TP list A(2) is the first vector in the TP list
- The order in which nominal size for each lineup pair is listed must also correspond with the positions of each respective lineup in the lineup lists (i.e., if lineup 1 has  $k = 6$ , then the first element of vector 'k' = 6)
- Data must be in a list format. This allows the function to compare lineups in which the number of choices and number of lineup members differs.
- The following warning will appear if vectors comprising lineup lists are of different lengths: *longer object length is not a multiple of shorter object length*. **This does not affect the accuracy of the function and can be ignored.**

## Value

Returns a dataframe containing:

- *n11*: Number of mock witnesses who identified the suspect in the target present condition
- *n21*: Number of mock witnesses who did not identify the suspect in the target present condition
- *n12*: Number of mock witnesses who identified the suspect in the target absent condition
- *n13*: Number of mock witnesses who did not identify the suspect in the target absent condition

## References

- Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.
- Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Tolia (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.
- Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.
- Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.
- Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

## Examples

```
#Target present data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
```

```

C <- round(runif(20,1,4))
lineup_pres_list <- list(A, B, C)
rm(A, B, C)

#Target absent data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
C <- round(runif(20,1,4))
lineup_abs_list <- list(A, B, C)
rm(A, B, C)

#Pos list
lineup1_pos <- c(1, 2, 3, 4, 5, 6)
lineup2_pos <- c(1, 2, 3, 4, 5)
lineup3_pos <- c(1, 2, 3, 4)
pos_list <- list(lineup1_pos, lineup2_pos, lineup3_pos)
rm(lineup1_pos, lineup2_pos, lineup3_pos)

#Nominal size:
k <- c(6, 5, 4)

#Call:
linedf <- diag_param(lineup_pres_list, lineup_abs_list, pos_list, k)

```

---

diag\_ratio\_T

*Diagnosticity Ratio (Tredoux, 1998)*


---

### Description

Computes Wells's adjusted diagnosticity ratio for one lineup pair (see: Tredoux, 1998)

### Usage

```
diag_ratio_T(lineup_pres, lineup_abs, pos_pres, pos_abs, k1, k2)
```

### Arguments

lineup_pres	A numeric vector of lineup choices for a lineup in which the target was present
lineup_abs	A numeric vector of lineup choices for a lineup in which the target was absent
pos_pres	A scalar, representing target position in TP lineup. Must be declared by user
pos_abs	A scalar, representing target position in TA lineup. Must be declared by user
k1	Number of targets in TP lineup. Must be specified by user (scalar).
k2	Number of targets in TA lineup. Must be specified by user (scalar).

## References

- Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.
- Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Tolia (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.
- Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.
- Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.
- Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

## Examples

```
#Data:
lineup_pres <- round(runif(100, 1, 6))
lineup_abs <- round(runif(70, 1, 5))
pos_pres <- 3
pos_abs <- 5

#Call:
diag_ratio_T(lineup_pres, lineup_abs, pos_pres, pos_abs, 6, 5)
diag_ratio_T(lineup_pres, lineup_abs, 3, 5, 6, 5)
```

---

diag\_ratio\_W

*Diagnosticity Ratio (Wells & Lindsay, 1980; Wells & Turtle, 1986)*

---

## Description

Computes Wells' diagnosticity ratio for one lineup pair

## Usage

```
diag_ratio_W(lineup_pres, lineup_abs, pos_pres, pos_abs, k1, k2)
```

## Arguments

lineup_pres	A numeric vector of lineup choices for a lineup in which the target was present
lineup_abs	A numeric vector of lineup choices for a lineup in which the target was absent
pos_pres	A scalar, representing target position in TP lineup. Must be declared by user
pos_abs	A scalar, representing target position in TA lineup. Must be declared by user
k1	Number of targets in TP lineup. Must be specified by user (scalar).
k2	Number of targets in TA lineup. Must be specified by user (scalar).

## References

Wells, G. L., & Lindsay, R. C. L. (1980). On estimating the diagnosticity of eyewitness nonidentifications. *Psychological Bulletin*, 88, 776-784.

Wells, G. L., & Turtle, J. W. (1986). Eyewitness identification: The importance of lineup models. *Psychological Bulletin*, 99, 320-329.

## Examples

```
#Data:
lineup_pres <- round(runif(100, 1, 6))
lineup_abs <- round(runif(70, 1, 5))
pos_pres <- 3
pos_abs <- 5

#Call:
diag_ratio_W(lineup_pres, lineup_abs, pos_pres, pos_abs, 6, 5)
diag_ratio_W(lineup_pres, lineup_abs, 3, 5, 6, 5)
```

---

d_bar	<i>Mean diagnosticity ratio for k lineup pairs</i>
-------	--

---

## Description

Function for computing pooled estimator from a set of k diagnosticity ratios

## Usage

```
d_bar(df)
```

## Arguments

df                    A dataframe containing rows: ln(d), variance of ln(d), d weights

## Details

. The order in which the estimates are bound together (i.e., their position in the dataframe) is important, and should always be as follows:

- row 1: var
- row 2: lnd
- row 3: wi

## Value

Mean diagnosticity ratio for k independent lineups

## References

Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.

Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Toglia (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.

Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.

Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.

Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

## Examples

```
#Target present data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
C <- round(runif(20,1,4))
lineup_pres_list <- list(A, B, C)
rm(A, B, C)

#Target absent data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
C <- round(runif(20,1,4))
lineup_abs_list <- list(A, B, C)
rm(A, B, C)

#Pos list
lineup1_pos <- c(1, 2, 3, 4, 5, 6)
lineup2_pos <- c(1, 2, 3, 4, 5)
lineup3_pos <- c(1, 2, 3, 4)
pos_list <- list(lineup1_pos, lineup2_pos, lineup3_pos)
rm(lineup1_pos, lineup2_pos, lineup3_pos)

#Nominal size:
k <- c(6, 5, 4)

#Use diag param helper function to get data (n11, n21, n12, n22):
linedf <- diag_param(lineup_pres_list, lineup_abs_list, pos_list, k)

#Compute ln(d):
ratio <- ln_diag_ratio(linedf)

#Compute variance of ln(d):
var <- var_lnd(linedf)

#Compute weights for pooled estimator:
```

```
wi <- d_weights(linedf)

#Bind ln(d), variance of ln(d) and weights into one df (of 3 rows & x observations)
#(see Details above):
df <- t(cbind(ratio, var, wi))

#Call:
d_bar(df)
```

---

d\_weights

*Diagnosticity ratio weights*

---

### Description

Function to compute weights of each diagnosticity ratio for k lineup pairs

### Usage

```
d_weights(linedf)
```

### Arguments

linedf            A dataframe of parameters for computing diagnosticity ratio

### Details

In order to obtain a pooled estimate of a set of diagnosticity ratios, we use a weight for each ratio that is equal to the inverse of its variance.

#### To get linedf, use the `diag_param` helper function

`diag_param` returns a dataframe containing the following:

- *n11*: Number of mock witnesses who identified the suspect in the target present condition
- *n21*: Number of mock witnesses who did not identify the suspect in the target present condition
- *n12*: Number of mock witnesses who identified the suspect in the target absent condition
- *n13*: Number of mock witnesses who did not identify the suspect in the target absent condition

### Value

A dataframe with one column containing weights for each pair of lineups for which diagnosticity ratio is being calculated.

### References

Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.

**Examples**

```

#Target present data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
C <- round(runif(20,1,4))
lineup_pres_list <- list(A, B, C)
rm(A, B, C)

#Target absent data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
C <- round(runif(20,1,4))
lineup_abs_list <- list(A, B, C)
rm(A, B, C)

#Pos list
lineup1_pos <- c(1, 2, 3, 4, 5, 6)
lineup2_pos <- c(1, 2, 3, 4, 5)
lineup3_pos <- c(1, 2, 3, 4)
pos_list <- list(lineup1_pos, lineup2_pos, lineup3_pos)
rm(lineup1_pos, lineup2_pos, lineup3_pos)

#Nominal size:
k <- c(6, 5, 4)

#Use diag param helper function to get data (n11, n21, n12, n22):
linedf <- diag_param(lineup_pres_list, lineup_abs_list, pos_list, k)

#Call:
wi <- d_weights(linedf)

```

---

 effsize\_compare

*Master Function: Comparing Effective Size*


---

**Description**

Function for comparing effective size of two independent lineups (Tredoux, 1998)

**Usage**

```
effsize_compare(linedf)
```

**Arguments**

**linedf**            A dataframe of lineup data. Contains 2 columns, each of which hold data for 2 independent lineups



## Details

This function is a master function, calling other functions it needs, and reporting results in some detail

## Value

Effective size, significance level, and confidence intervals (95 normal theory, percentile & bias-corrected)

## References

Davison, A.C. & Hinkley, D.V. (1997). *Bootstrap methods and their application*. Cambridge University Press.

Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.

Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Tolia (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.

Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.

Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.

Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

## See Also

**boot**: <https://cran.r-project.org/web/packages/boot/boot.pdf>

## Examples

```
#Data:

lineup_vec1 <- round(runif(100, 1, 6))
lineup_vec2 <- round(runif(100, 1, 6))
linedf <- as.data.frame(cbind(lineup_vec1, lineup_vec2))

#Call:
x <- effsize_compare(linedf)
```

---

eff\_size\_per\_foils      *Effective Size per Foils*

---

### Description

Function for computing effective size (Malpass, 1981) counting foils who fall within the CI for chance guessing

### Usage

```
eff_size_per_foils(lineup_vec, target_pos, k, conf = 0.95)
```

### Arguments

lineup_vec	A numeric vector of lineup choices
target_pos	A numeric vector indexing all lineup members
k	Number of members in lineup. Must be specified by user (scalar).
conf	Desired level of alpha. Defaults to 0.95. May be specified by user (scalar).

### References

Malpass, R S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5, 299-309.

Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.

### Examples

```
#Data:
lineup_vec <- round(runif(100, 1, 6))
target_pos <- c(1, 2, 3, 4, 5, 6)

#Call:
eff_size_per_foils(lineup_vec, target_pos, 6)
eff_size_per_foils(lineup_vec, target_pos, conf = 0.95, 6)
```

---

esize\_m      *Effective Size*

---

### Description

Function for computing Effective Size

### Usage

```
esize_m(lineup_table, k, both = FALSE)
```

## Arguments

lineup_table	A table of lineup choices
k	Number of members in lineup. Must be specified by user (scalar).
both	Defaults to FALSE. Returns Tredoux's adjusted effective size estimate. If TRUE, provides both Malpass's (1981) and Makpass's adjusted (see: Tredoux, 1998) calculations of effective size.

## Details

Reduces the size of a lineup from a (corrected) nominal starting value by the degree to which members are, in sum, chosen below the level of chance expectation.

## Value

Malpass's original & adjusted estimates of effective size

## References

Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.

Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Toglia (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.

Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.

Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.

Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

## Examples

```
#Data:
lineup_vec <- round(runif(100, 1, 6))

#Call:
esize_m(lineup_vec, 6, both = TRUE)
esize_m(lineup_vec, 6)
```

---

esize_m_boot	<i>Bootstrapped Effective Size</i>
--------------	------------------------------------

---

### Description

Base function for computing bootstrapped effective size

### Usage

```
esize_m_boot(lineup_vec, d, k)
```

### Arguments

lineup_vec	A vector of lineup choices
d	Indices for bootstrap resampling
k	A vector indexing number of members in each lineup pair. Must be specified by user (scalar).

### Details

Function to call when bootstrap resampling using boot function (in package 'boot')

### Value

If printarg=FALSE, provides only Malpass's original calculation of effective size

### References

- Davison, A.C. & Hinkley, D.V. (1997). *Bootstrap methods and their application*. Cambridge University Press.
- Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.
- Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Tolia (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.
- Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.
- Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.
- Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

### See Also

[boot](https://cran.r-project.org/web/packages/boot/boot.pdf): <https://cran.r-project.org/web/packages/boot/boot.pdf>

## Examples

```
#Data:
lineup_vec <- round(runif(100, 1, 6))

#Get boot object:
bootobject <- boot::boot(lineup_vec, esize_m_boot, k = 6, R=1000)
bootobject

#To get confidence intervals:
cis <- boot::boot.ci(bootobject, conf = 0.95, type = "all")
```

---

esize\_T

*Effective Size (Tredoux, 1998)*

---

## Description

Function for generating Effective Size (Tredoux, 1998)

## Usage

```
esize_T(lineup_table)
```

## Arguments

lineup\_table    A table of lineup choices

## Details

Reduces the size of a lineup from a (corrected) nominal starting value by the degree to which members are, in sum, chosen below the level of chance expectation.

## References

- Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.
- Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Toggia (Eds.), *Handbook of Eyewitness Psychology*, Vol. 2: Memory for people (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.
- Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.
- Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.
- Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

## Examples

```
#Data:
lineup_vec <- round(runif(100, 1, 6))
lineup_table <- table(lineup_vec)

#Call:
e <- esize_T(lineup_table)
```

---

esize\_T\_boot

*Bootstrapped Effective Size (Tredoux, 1998)*

---

## Description

Base function for generating bootstrapped Effective Size (Tredoux, 1998)

## Usage

```
esize_T_boot(lineup_table, d)
```

## Arguments

lineup\_table    A table of lineup choices  
d                Indices for bootstrap resampling

## Details

Reduces the size of a lineup from a (corrected) nominal starting value by the degree to which members are, in sum, chosen below the level of chance expectation.

## References

- Davison, A.C. & Hinkley, D.V. (1997). *Bootstrap methods and their application*. Cambridge University Press.
- Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.
- Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Toglia (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.
- Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.
- Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.
- Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

**See Also**

[boot](https://cran.r-project.org/web/packages/boot/boot.pdf): <https://cran.r-project.org/web/packages/boot/boot.pdf>

---

esize_T_ci_n	<i>Effective Size with Confidence Intervals from Normal Theory (Tredoux, 1998)</i>
--------------	--

---

**Description**

Function for generating Effective Size (Tredoux, 1998) with CIs from normal theory

**Usage**

```
esize_T_ci_n(lineup_table, alpha)
```

**Arguments**

lineup_table	A table of lineup choices
alpha	Alpha level to be declared by user (scalar)

**Details**

Reduces the size of a lineup from a (corrected) nominal starting value by the degree to which members are, in sum, chosen below the level of chance expectation

**References**

- Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.
- Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Togli (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.
- Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.
- Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.
- Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

**Examples**

```
#Data:
lineup_vec <- round(runif(100, 1, 6))
lineup_table <- table(lineup_vec)

#Call:
e_ci <- esize_T_ci_n(lineup_table, .95)
```

---

face_sim	<i>Compute similarity of faces in a lineup; experimental function</i>
----------	---

---

### Description

Function to compute the degree to which each face in a set of faces loads onto a common factor computed from the faces.

### Usage

```
face_sim()
```

### Details

- The faces need to be standardized for inter-pupil distance, and for pupil location prior to running the function
- The user will be asked to choose a set of faces through a dialog box. These should be jpeg files.
- There is no argument to the function; it gets what it needs from the dialog box. The function prints the lineup array to the viewer pane in R, and reports the loading of each face on the first common factor in a factor analysis (using fa in package psych)

### References

Tredoux, C. (2002). A direct measure of facial similarity and its relation to human similarity perceptions. *Journal of Experimental Psychology: Applied*, 8(3), 180-193. doi:10.1037/1076-898x.8.3.180

---

func_size	<i>Functional Size</i>
-----------	------------------------

---

### Description

This function computes functional size ( $N/D$ ), where  $N$  = number of mock witnesses, &  $D$  = number of mock witnesses choosing the target

### Usage

```
func_size(lineup_vec, target_pos)
```

### Arguments

lineup_vec	A numeric vector of lineup choices
target_pos	A scalar, representing target position in lineup. Must be declared by user



**Details**

An estimation of the number of plausible lineup members in a given lineup.

**Value**

Functional size of lineup

**References**

Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.

Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.

Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

**Examples**

```
#Data:
lineup_vec <- round(runif(100, 1, 6))
target_pos <- 3

#Call:
x <- func_size(lineup_vec, target_pos)
x <- func_size(lineup_vec, 3)
```

---

func\_size.boot

*Bootstrapped Functional Size*

---

**Description**

This function is a base function for the bootstrapping that ensues to compute bootstrapped confidence intervals for the estimate of functional size

**Usage**

```
func_size.boot(lineup_vec, d = d, target_pos)
```

**Arguments**

lineup_vec	A numeric vector of lineup choices
d	Indices for bootstrap resampling
target_pos	A scalar, representing position of target in lineup. Must be declared by user

## Details

Function is called bootstrap resampling using boot function (in package 'boot') This function is never called by the user - it is called in the functional size master function

## References

Davison, A.C. & Hinkley, D.V. (1997). *Bootstrap methods and their application*. Cambridge University Press.

Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.

Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.

Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

## See Also

**boot**: <https://cran.r-project.org/web/packages/boot/boot.pdf>

---

func\_size\_report

*Functional Size with Bootstrapped Confidence Intervals*

---

## Description

This function is a master function, calling other functions it needs, and reporting results in some detail

## Usage

```
func_size_report(lineup_vec, target_pos, k, R)
```

## Arguments

lineup_vec	A numeric vector of lineup choices
target_pos	A scalar, representing target position in lineup. Must be declared by user
k	Number of members in lineup. Must be specified by user (scalar).
R	Number of bootstrap samples. Defaults to 1000

## Details

Function depends on functions from package 'boot'

## References

- Davison, A.C. & Hinkley, D.V. (1997). *Bootstrap methods and their application*. Cambridge University Press.
- Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.
- Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.
- Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

## See Also

[boot](https://cran.r-project.org/web/packages/boot/boot.pdf): <https://cran.r-project.org/web/packages/boot/boot.pdf>

## Examples

```
#Data:
lineup_vec <- round(runif(100, 1, 6))
target_pos <- 3

#Call:
x <- func_size_report(lineup_vec, target_pos, 6)
x <- func_size_report(lineup_vec, 3, 6)
```

---

gen_boot_propci	<i>Percentile of Bootstrapped Lineup Proportion</i>
-----------------	---

---

## Description

Function for computing arbitrary percentile of bootstrapped lineup proportion

## Usage

```
gen_boot_propci(lineupprops, perc = 0.05)
```

## Arguments

lineupprops	A vector of bootstrapped lineup proportions
perc	Percentile to be computed. Must be declared by user (scalar) Defaults to .05

## Details

Can be used to calculate confidence intervals at desired level of alpha

**Value**

Arbitrary percentile of bootstrapped lineup proportion

**Examples**

```
#Data:
lineup_vec <- round(runif(100, 1, 6))
target_pos <- 3
k <- 6

#Bootstrap data:
lineup_boot_df <- gen_boot_samples(lineup_vec, 1000)

#Compute proportion for bootstrap samples:
lineup_props <- gen_lineup_prop(lineup_boot_df, target_pos, 6)

#Get boot CIs:
prop_bootci_lower <- gen_boot_propci(lineup_props, perc = .025)
prop_bootci_upper <- gen_boot_propci(lineup_props, perc = .975)
```

---

gen\_boot\_propmean\_se *Descriptive statistics for bootstrapped lineup proportion*

---

**Description**

Function for computing mean, med and se of boot proportion

**Usage**

```
gen_boot_propmean_se(lineup_props)
```

**Arguments**

lineup\_props      A dataframe of bootstrapped lineup proportions

**Value**

Mean, median, standard deviation, standard error & 95 CIs of lineup proportion across a bootstrapped dataframe

**Examples**

```
#Data:
lineup_vec <- round(runif(100, 1, 6))
target_pos <- 3

#Bootstrap data:
lineup_boot_df <- gen_boot_samples(lineup_vec, 1000)
```

```
#Compute proportion for bootstrap samples:
lineupprops <- gen_lineup_prop(lineup_boot_df, target_pos = 3, k = 6)

#Call:
gen_boot_propmean_se(lineupprops)

#OR:

lineupprops <- boot::boot(lineup_vec, lineup_prop_boot, target_pos = 3, R = 1000)
gen_boot_propmean_se(lineupprops$t)
```

---

gen_boot_samples	<i>Bootstrap resampling</i>
------------------	-----------------------------

---

## Description

Function for generating bootstrapped samples from 1 vector of lineup data

## Usage

```
gen_boot_samples(lineup_vec, bootno)
```

## Arguments

lineup_vec	A numeric vectors of lineup choices
bootno	Number of bootstrap samples

## Value

A dataframe of bootstrapped lineup data

## Examples

```
#Data:
lineup_vec <- round(runif(100,1,6))
bootno <- 1000

#Call:
bootdf <- gen_boot_samples(lineup_vec, bootno)
```

---

gen\_boot\_samples\_list *Bootstrapped resampling*

---

**Description**

Function for generating bootstrapped samples for of k vectors of lineup choices

**Usage**

```
gen_boot_samples_list(lineup_list, bootno)
```

**Arguments**

lineup\_list      A list containing k vectors of lineup choices for k lineups, in which the target was either absent or present

bootno            Number of bootstrap samples

**Value**

A list of bootstrapped lineup data Length of list = no. of bootstrap sample draws

**Examples**

```
#Data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
C <- round(runif(20,1,4))
linelist <- list(A, B, C)
rm(A, B, C)

bootno <- 1000

#Call:
bootdata <- gen_boot_samples_list(linelist, bootno)
```

---

gen\_esize\_m                      *Effective Size (across a dataframe)*

---

**Description**

Function for computing Effective Size (Tredoux, 1998) on lineups contained as columns in a df, usually from a bootstrapped sample

**Usage**

```
gen_esize_m(lineup_boot_df, k)
```

**Arguments**

lineup\_boot\_df A dataframe containing bootstrapped samples of lineup data  
 k Number of members in lineup. Must be specified by user (scalar).

**Details**

This function computes effective size for k lineups simultaneously.

**Value**

A vector of effective size calculations for each lineup in bootstrapped df

**References**

- Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.
- Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Toglia (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.
- Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.
- Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.
- Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

**Examples**

```
#Data:
lineup_vec <- round(runif(100,1,6))
bootdf <- gen_boot_samples(lineup_vec, 1000)

#Call:
esize_vec <- gen_esize_m(bootdf, 6)
```

---

 gen\_esize\_m\_ci

*Bootstrapped Confidence Intervals for Effective Size*


---

**Description**

Function for computing Effective Size (Malpass, 1981, as adjusted by Tredoux, 1998) with CIs from bootstrap df of lineups

**Usage**

```
gen_esize_m_ci(lineupsizes, perc = 0.05)
```

**Arguments**

lineupsizes     A vector of bootstrapped effective sizes  
 perc            Defaults to .05. Can be specified by user, according to desired level of alpha (scalar)

**Value**

Confidence intervals for effective size

**Examples**

```
#Data:
lineup_vec <- round(runif(100, 1, 6))
k <- 6

#Use gen_boot_samples to get bootstrapped data:
bootdata <- gen_boot_samples(lineup_vec, 1000)

#Compute effective size over df of bootstrapped data:
lineupsizes <- gen_esize_m(bootdata, 6)

#Call:
gen_esize_m_ci(lineupsizes)
gen_esize_m_ci(lineupsizes, perc = .025)
gen_esize_m_ci(lineupsizes, perc = .975)
```

---

gen\_lineup\_prop     *Lineup proportion over dataframe*

---

**Description**

Function for computing lineup proportion over a dataframe

**Usage**

```
gen_lineup_prop(lineup_boot_df, target_pos, k)
```

**Arguments**

lineup\_boot\_df     Dataframe of lineup choices (usually a bootstrapped set)  
 target\_pos        A scalar, representing target position in lineup. Must be declared by user.  
 k                  A vector indexing number of members in each lineup pair (nominal size). Must be specified by user (scalar).

**Value**

A vector of bootstrapped proportions, indicating the frequency with which a target was identified in a lineup Length of vector = number of bootstrap sample draws



**Examples**

```
#Data
lineup_vec <- round(runif(100, 1, 6))
target_pos <- 3

#Get bootstrapped data:
lineup_boot_df <- gen_boot_samples(lineup_vec, 1000)

#Call:
lineup_props <- gen_lineup_prop(lineup_boot_df, 3, 6)
```

---

gen_linevec	<i>Lineup vector</i>
-------------	----------------------

---

**Description**

A function that takes a table of lineup choices and generates a vector of raw lineup data

**Usage**

```
gen_linevec(lineup_table, k)
```

**Arguments**

lineup\_table    A table of lineup choices  
k                Nominal size (i.e., total number of lineup members). Must be declared by user

**Value**

Returns a vector of lineup choices

**Examples**

```
#Data:
lineup_vec <- round(runif(100, 1, 6))
lineup_table <- table(lineup_vec)

#Call:
lineup_vec <- gen_linevec(lineup_table, 3)
```

---

 homog\_diag

*Master function: Homogeneity of diagnosticity ratio*


---

### Description

This function provides assesses the homogeneity of the diagnosticity ratio of k lineup pairs.

### Usage

```
homog_diag(lineup_pres_list, lineup_abs_list, pos_list, k)
```

### Arguments

lineup_pres_list	A list containing k vectors of lineup choices for k lineups, in which the target was present
lineup_abs_list	A list containing k vectors of lineup choices for k lineups, in which the target was absent
pos_list	A numeric vector indexing lineup member positions for the target present & absent conditions.
k	A vector indexing number of members in each lineup pair (nominal size). Must be specified by user (scalar).

### Details

Master function for assessing homogeneity of diagnosticity ratio for k independent lineups.

### Value

Computes diagnosticity ratio with chi-squared estimate and significance level for k lineup pairs

### References

- Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.
- Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Toglia (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.
- Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.
- Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.
- Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

**Examples**

```

#Target present data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
C <- round(runif(20,1,4))
lineup_pres_list <- list(A, B, C)
rm(A, B, C)

#Target absent data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
C <- round(runif(20,1,4))
lineup_abs_list <- list(A, B, C)
rm(A, B, C)

#Pos list
lineup1_pos <- c(1, 2, 3, 4, 5, 6)
lineup2_pos <- c(1, 2, 3, 4, 5)
lineup3_pos <- c(1, 2, 3, 4)
pos_list <- list(lineup1_pos, lineup2_pos, lineup3_pos)
rm(lineup1_pos, lineup2_pos, lineup3_pos)

#Nominal size:
k <- c(6, 5, 4)

#Call:
homog_diag(lineup_pres_list, lineup_abs_list, pos_list, k)

```

---

homog\_diag\_boot

*Homogeneity of diagnosticity ratio with bootstrapped CIs*


---

**Description**

Function for computing bootstrapped estimates of homogeneity of diagnosticity ratio

**Usage**

```
homog_diag_boot(lineup_pres_list, lineup_abs_list, k, R = 100)
```

**Arguments**

lineup_pres_list	A list containing k vectors of lineup choices for k lineups, in which the target was present
lineup_abs_list	A list containing k vectors of lineup choices for k lineups, in which the target was absent
k	Number of members in lineup. Must be specified by user (scalar).
R	Number of bootstrap replications. Defaults to R = 100.

**Details**

Computes bootstrapped diagnosticity ratio with chi-squared estimate, significance level and confidence intervals for k lineup pairs

**References**

Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.

Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Toglia (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.

Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.

Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.

Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

**Examples**

```
#Target present data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
C <- round(runif(20,1,4))
lineup_pres_list <- list(A, B, C)
rm(A, B, C)
```

```
#Target absent data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
C <- round(runif(20,1,4))
lineup_abs_list <- list(A, B, C)
rm(A, B, C)
```

---

i\_size\_T

*I Component of Effective Size(Tredoux, 1998)*


---

**Description**

Function for generating I component of effective size

**Usage**

```
i_size_T(lineup_table)
```

**Arguments**

lineup\_table    A table of lineup choices

**References**

Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.

Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Toglia (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.

Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.

Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.

Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

**Examples**

```
#Data:
lineup_vec <- round(runif(100, 1, 6))
lineup_table <- table(lineup_vec)

#Call:
i <- i_esize_T(lineup_table)
```

---

line73

---

*line73*


---

**Description**

A dataframe of lineup choices for 1 trial; real data from a Doob & Kirshenbaum (1973) article. This article was the first to discuss lineup size 1 column x 42 observations

42 mock witnesses Nominal size is 6 Target position is 4

**Usage**

```
data(line73)
```

**Format**

An object of class `data.frame` with 42 rows and 1 columns.

**References**

Doob, A. N., & Kirshenbaum, H. M. (1973). Bias in police lineups-Partial remembering. *Journal of Police Science and Administration*, 1, 287-293.

---

lineup\_boot\_allprop    *Confidence intervals for lineup proportion*

---

**Description**

Computes bootstrapped confidence intervals for lineup proportion

**Usage**

```
lineup_boot_allprop(lineup_vec, k, conf = 0.95)
```

**Arguments**

lineup_vec	A numeric vector of lineup choices
k	Number of targets in lineup. Must be specified by user (scalar).
conf	Desired level of alpha. Defaults to 0.95. May be specified by user (scalar).

**Details**

Function that computes bootstrapped lineup proportion using 1000 bootstrap draws Calls 'boot' function in 'boot' package

**Value**

Returns a vector of bias corrected confidence intervals for lineup proportion for each member in a lineup

**References**

Davison, A.C. & Hinkley, D.V. (1997). *Bootstrap methods and their application*. Cambridge University Press.

Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

**See Also**

**boot**: <https://cran.r-project.org/web/packages/boot/boot.pdf>

**Examples**

```
#Data:
lineup_vec <- round(runif(100, 1, 6))

#Call:
lineupprops_ci <- lineup_boot_allprop(lineup_vec, k= 6)
lineupprops_ci <- lineup_boot_allprop(lineup_vec, k= 6, conf = 0.975)
```

---

lineup_prop_boot	<i>Bootstrapped lineup proportion</i>
------------------	---------------------------------------

---

### Description

Base function for computing bootstrapped lineup proportion for a lineup member

### Usage

```
lineup_prop_boot(lineup_vec, d, target_pos)
```

### Arguments

lineup_vec	A numeric vector of lineup choices
d	Indices for bootstrap sample. Argument used by boot function to select samples for bootstrapping
target_pos	A scalar, representing target position in lineup. Must be declared by user

### Details

Function to call when bootstrap resampling using boot function

### References

Davison, A.C. & Hinkley, D.V. (1997). *Bootstrap methods and their application*. Cambridge University Press.

Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

### See Also

**boot**: <https://cran.r-project.org/web/packages/boot/boot.pdf>

### Examples

```
lineup_vec <- round(runif(100, 1, 6))

bootobject <- boot::boot(lineup_vec, lineup_prop_boot, target_pos = 3, R = 1000)
cis <- boot::boot.ci(bootobject, conf = 0.95, type = "all")
```

lineup\_prop\_tab      *Lineup proportion*

---

**Description**

Computes the proportion of mock witnesses identifying a particular lineup member

**Usage**

```
lineup_prop_tab(lineup_table, target_pos)
```

**Arguments**

lineup\_table      A table of lineup choices  
target\_pos        A scalar, representing target position in lineup. Must be declared by user

**Value**

Returns a proportion indicating the frequency with which a lineup member was selected

**References**

Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

**Examples**

```
#Data:  
lineup_vec <- round(runif(100, 1))  
lineup_table <- table(lineup_vec)  
  
#Call:  
lineup_prop_tab(lineup_table, 3)  
lineup_prop_tab(table(lineup_vec), 2)
```

---

lineup\_prop\_vec      *Lineup proportion*

---

**Description**

Computes the proportion of mock witnesses identifying a particular lineup member

**Usage**

```
lineup_prop_vec(lineup_vec, target_pos, k)
```



**Arguments**

lineup_vec	A numeric vector of lineup choices
target_pos	Suspect/lineup member position. Must be declared by user (scalar).
k	Nominal size (i.e., total number of members in lineup). Must be specified by user (scalar).

**Value**

Returns a proportion indicating the frequency with which a target was identified in a lineup

**References**

Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

**Examples**

```
#Data:
lineup_vec <- round(runif(100, 1, 6))

#Call:
lineup_prop_vec(lineup_vec, 3, 6)
```

---

ln_diag_ratio	<i>Ln of Diagnosticity Ratio</i>
---------------	----------------------------------

---

**Description**

Computes ln of diagnosticity ratio: ln(d)

**Usage**

```
ln_diag_ratio(linedf)
```

**Arguments**

linedf	A dataframe of parameters for computing diagnosticity ratio
--------	---

**Details****To get linedf, use the diag\_param helper function**

*diag\_param* returns a dataframe containing the following:

- *n11*: Number of mock witnesses who identified the suspect in the target present condition
- *n21*: Number of mock witnesses who did not identify the suspect in the target present condition
- *n12*: Number of mock witnesses who identified the suspect in the target absent condition
- *n13*: Number of mock witnesses who did not identify the suspect in the target absent condition

## References

Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.

Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Toglia (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.

Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.

Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.

Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

## Examples

```
#Target present data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
C <- round(runif(20,1,4))
lineup_pres_list <- list(A, B, C)
rm(A, B, C)

#Target absent data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
C <- round(runif(20,1,4))
lineup_abs_list <- list(A, B, C)
rm(A, B, C)

#Pos list
lineup1_pos <- c(1, 2, 3, 4, 5, 6)
lineup2_pos <- c(1, 2, 3, 4, 5)
lineup3_pos <- c(1, 2, 3, 4)
pos_list <- list(lineup1_pos, lineup2_pos, lineup3_pos)
rm(lineup1_pos, lineup2_pos, lineup3_pos)

#Nominal size:
k <- c(6, 5, 4)

#Use diag param helper function to get data (n11, n21, n12, n22):
linedf <- diag_param(lineup_pres_list, lineup_abs_list, pos_list, k)

#Call:
lnd <- ln_diag_ratio(linedf)
```

---

makevec_prop	<i>Helper functions</i>
--------------	-------------------------

---

**Description**

Several helper functions that compute bootcisc from proportions

**Usage**

```
makevec_prop(prop, n)
```

**Arguments**

prop	A dataframe of bootstrapped proportions
n	Number of lineup members

---

make_roc	<i>Compute and plot ROC curve for lineup accuracy ~ confidence</i>
----------	--

---

**Description**

Function to compute and plot an ROC curve for data from an eyewitness experiment, where accuracy is recorded for target present and target absent lineups

**Usage**

```
make_roc(df_confacc)
```

**Arguments**

df_confacc	A dataframe with two columns, named confidence and accuracy (where accuracy = binary accuracy)
------------	--

**Details**

The approach is outlined in several papers by Mickes, Wixted, Gronlund, Clark, and others (see **References**)

This function is a user level function. It chains the two roc functions together. The user must pass a dataframe, with one column indicating confidence, and another accuracy, and these must be named as such.

The approach is outlined in several papers by Mickes, Wixted, Gronlund, Clark, and others (see references)

**Value**

An ROC object of package pROC

## References

Gronlund, S. D., Wixted, J. T., & Mickes, L. (2014). Evaluating eyewitness identification procedures using receiver operating characteristic analysis. *Current Directions in Psychological Science*, 23(1), 3-10.

## Examples

```
#Data:
data(mickwick)

#Call:
make_roc(mickwick)
```

---

make_rocdata	<i>Helper functions: Compute and plot ROC curve for lineup accuracy ~ confidence</i>
--------------	--

---

## Description

Function to compute and plot an ROC curve for data from an eyewitness experiment, where accuracy is recorded for target present and target absent lineups

## Usage

```
make_rocdata(df_confacc)
```

## Arguments

df_confacc	A df with two columns, confidence and accuracy, where accuracy = binary accuracy.
------------	---

## Value

An ROC object of package pROC

---

mickwick	<i>Confidence &amp; Accuracy data (Mickes &amp; Wixted)</i>
----------	---

---

**Description**

Data capturing confidence and accuracy for a lineup trial

**Usage**

```
data(mickwick)
```

**Format**

An object of class `tbl_df` (inherits from `tbl`, `data.frame`) with 100 rows and 2 columns.

**Details**

mickwick

---

mockdata	<i>mockdata</i>
----------	-----------------

---

**Description**

A dataframe containing real lineup data.

3 columns x 94 observations.

The first column simply provides the participant number, whilst the second and third contain data for each participant's choice (i.e., the position of the lineup member that they identified) and a confidence score for each choice.

In the field of eyewitness testimony, it is common for participants to rate how confident they are that they have accurately identified the perpetrator. Here, confidence is recorded as a percentage.

This lineup has the following parameters:

- 94 mock witness choices
- Target position is 7
- Nominal size is 9

**Usage**

```
data(mockdata)
```

**Format**

An object of class `tbl_df` (inherits from `tbl`, `data.frame`) with 94 rows and 3 columns.

---

 nortje2012

*nortje2012*


---

### Description

A data file containing lineup data for 3 independent lineups. 133 rows x 3 columns. Each lineup trial consisted of 133 mock witnesses & 8 lineup members.

- : Target position for lineup 1 is 3
- : Target position for lineup 2 is 6
- : Target position for lineup 3 is 2

### Usage

```
data(nortje2012)
```

### Format

An object of class `tbl_df` (inherits from `tbl`, `data.frame`) with 133 rows and 3 columns.

---

 rep\_index

*Rep index*


---

### Description

Helper function that repeats a number k times

### Usage

```
rep_index(index, num)
```

### Arguments

index	Number to be repeated
num	Number of times to repeat index

### Details

Can be used to create vectors of lineup data

### Examples

```
rep_index(1, 10)
```

---

rot_vector	<i>Rotate vector</i>
------------	----------------------

---

**Description**

Helper function to rotate vector

**Usage**

```
rot_vector(lineup_vec)
```

**Arguments**

lineup_vec	A vector of lineup data
------------	-------------------------

---

show_lineup	<i>Helper function</i>
-------------	------------------------

---

**Description**

Helper function

**Usage**

```
show_lineup(file_list)
```

**Arguments**

file_list	A selection of image files (raw data)
-----------	---------------------------------------

---

var_diag_ratio	<i>Variance of diagnosticity ratio (Tredoux)</i>
----------------	--

---

**Description**

Computes the variance of the diagnosticity ratio for a lineup pair

**Usage**

```
var_diag_ratio(lineup_pres, lineup_abs, pos_pres, pos_abs, k1, k2)
```

**Arguments**

lineup_pres	A numeric vector of lineup choices for a lineup in which the target was present
lineup_abs	A numeric vector of lineup choices for a lineup in which the target was absent
pos_pres	A scalar, representing target position in TP lineup. Must be declared by user
pos_abs	A scalar, representing target position in TA lineup. Must be declared by user
k1	Number of targets in TP lineup. Must be specified by user (scalar).
k2	Number of targets in TA lineup. Must be specified by user (scalar).

**References**

Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.

Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Toglia (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.

Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.

Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.

Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

**Examples**

```
#Data:
lineup_pres <- round(runif(100, 1, 6))
lineup_abs <- round(runif(100, 1, 6))
pos_pres <- 3
pos_abs <- 4

#Call:
var_d <- var_diag_ratio(lineup_pres, lineup_abs, pos_pres, pos_abs, 6, 6)
var_d <- var_diag_ratio(lineup_pres, lineup_abs, 3, 4, 6, 6)
```

---

var\_lnd

*Variance of ln of diagnosticity ratio*


---

**Description**

Function to compute variance of ln(d) for k lineup pairs

**Usage**

```
var_lnd(linedf)
```



## Arguments

linedf            A dataframe of parameters for computing diagnosticity ratio

## Details

### To get linedf, use the diag\_param helper function

*diag\_param* returns a dataframe containing the following:

- *n11*: Number of mock witnesses who identified the suspect in the target present condition
- *n21*: Number of mock witnesses who did not identify the suspect in the target present condition
- *n12*: Number of mock witnesses who identified the suspect in the target absent condition
- *n13*: Number of mock witnesses who did not identify the suspect in the target absent condition

## Value

A dataframe containing ln of the variance of the diagnosticity ratio for each lineup.

## References

Malpass, R. S. (1981). Effective size and defendant bias in eyewitness identification lineups. *Law and Human Behavior*, 5(4), 299-309.

Malpass, R. S., Tredoux, C., & McQuiston-Surrett, D. (2007). Lineup construction and lineup fairness. In R. Lindsay, D. F. Ross, J. D. Read, & M. P. Tolia (Eds.), *Handbook of Eyewitness Psychology, Vol. 2: Memory for people* (pp. 155-178). Mahwah, NJ: Lawrence Erlbaum Associates.

Tredoux, C. G. (1998). Statistical inference on measures of lineup fairness. *Law and Human Behavior*, 22(2), 217-237.

Tredoux, C. (1999). Statistical considerations when determining measures of lineup size and lineup bias. *Applied Cognitive Psychology*, 13, S9-S26.

Wells, G. L., Leippe, M. R., & Ostrom, T. M. (1979). Guidelines for empirically assessing the fairness of a lineup. *Law and Human Behavior*, 3(4), 285-293.

## Examples

```
#Target present data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
C <- round(runif(20,1,4))
lineup_pres_list <- list(A, B, C)
rm(A, B, C)
```

```
#Target absent data:
A <- round(runif(100,1,6))
B <- round(runif(70,1,5))
C <- round(runif(20,1,4))
lineup_abs_list <- list(A, B, C)
rm(A, B, C)
```

```
#Pos list
lineup1_pos <- c(1, 2, 3, 4, 5, 6)
lineup2_pos <- c(1, 2, 3, 4, 5)
lineup3_pos <- c(1, 2, 3, 4)
pos_list <- list(lineup1_pos, lineup2_pos, lineup3_pos)
rm(lineup1_pos, lineup2_pos, lineup3_pos)

#Nominal size:
k <- c(6, 5, 4)

#Use diag param helper function to get data (n11, n21, n12, n22):
linedf <- diag_param(lineup_pres_list, lineup_abs_list, pos_list, k)
#Call:
var <- var_lnd(linedf)
```

# Index

## \* datasets

- line73, [37](#)
- mickwick, [45](#)
- mockdata, [45](#)
- nortje2012, [46](#)

allfoil\_cihigh, [4](#)  
allfoilbias, [3](#)  
allprop, [4](#)

boot, [17](#), [20](#), [23](#), [26](#), [27](#), [38](#), [39](#)

chi\_diag, [5](#)  
compare\_eff\_sizes.boot, [6](#)

d\_bar, [13](#)  
d\_weights, [15](#)  
datacheck1, [7](#)  
datacheck2, [8](#)  
datacheck3, [9](#)  
diag\_param, [9](#)  
diag\_ratio\_T, [11](#)  
diag\_ratio\_W, [12](#)

eff\_size\_per\_foils, [18](#)  
effsize\_compare, [16](#)  
esize\_m, [18](#)  
esize\_m\_boot, [20](#)  
esize\_T, [21](#)  
esize\_T\_boot, [22](#)  
esize\_T\_ci\_n, [23](#)

face\_sim, [24](#)  
func\_size, [24](#)  
func\_size.boot, [25](#)  
func\_size\_report, [26](#)

gen\_boot\_propci, [27](#)  
gen\_boot\_propmean\_se, [28](#)  
gen\_boot\_samples, [29](#)  
gen\_boot\_samples\_list, [30](#)

gen\_esize\_m, [30](#)  
gen\_esize\_m\_ci, [31](#)  
gen\_lineup\_prop, [32](#)  
gen\_linevec, [33](#)

homog\_diag, [34](#)  
homog\_diag\_boot, [35](#)

i\_esize\_T, [36](#)

line73, [37](#)  
lineup\_boot\_allprop, [38](#)  
lineup\_prop\_boot, [39](#)  
lineup\_prop\_tab, [40](#)  
lineup\_prop\_vec, [40](#)  
ln\_diag\_ratio, [41](#)

make\_roc, [43](#)  
make\_rocdata, [44](#)  
makevec\_prop, [43](#)  
mickwick, [45](#)  
mockdata, [45](#)

nortje2012, [46](#)

rep\_index, [46](#)  
rot\_vector, [47](#)

show\_lineup, [47](#)

var\_diag\_ratio, [47](#)  
var\_lnd, [48](#)