

# Package ‘DanielBiostatistics10th’

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Biostatistics: A Foundation for Analysis in the Health  
Sciences, Tenth Edition.

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 DanielBiostatistics10th-package

*Functions for Wayne W. Daniel's Biostatistics (Tenth Edition)*


---

### Description

Functions and examples to accompany Wayne W. Daniel's *Biostatistics: A Foundation for Analysis in the Health Sciences*, Tenth Edition, Wiley, ISBN: 978-1-119-62550-6.

<https://www.wiley.com/en-us/Biostatistics:+A+Foundation+for+Analysis+in+the+Health+Sciences,+10th+Edition-p-9781119625506>

Data sets from 10th edition <https://bcs.wiley.com/he-bcs/Books?action=resource&bcsId=7849&itemId=1118302796&resourceId=30373>.

Resources from 11th edition <https://bcs.wiley.com/he-bcs/Books?action=index&bcsId=11491&itemId=1119496578>, with errata of data.

---

 binom2pois

*Binomial Approaching Poisson*


---

### Description

Binomial Approaching Poisson

### Usage

```
binom2pois(x, lambda, size = c(10L, 100L))
```

### Arguments

x	<a href="#">integer</a> scalar, observed number of responses
lambda	positive <a href="#">numeric</a> scalar, parameter $\lambda$ of Poisson distribution
size	<a href="#">integer</a> vector, parameter $n$ of binomial distribution

### Details

[binom2pois](#) shows how binomial density approaches Poisson density when  $n \rightarrow \infty$  and  $p \rightarrow 0$ , while holding a constant product  $np = \lambda$ .

### Value

[binom2pois](#) returns a [binom2pois](#) object, for which a [print](#) method, an [autolayer](#) and an [autoplot](#) method are defined.

### See Also

[dbinom](#) [dpois](#)

**Examples**

```
binom2pois(x = 4L, lambda = 6, size = seq.int(10L, 50L, by = 10L))
```

---

BooleanRisk-class      *Boolean Risk-&-Disease Table*

---

**Description**

Boolean Risk-&-Disease Table

**Slots**

.Data two-by-two [integer matrix](#), contingency table of a Boolean test-&-disease decisions with layout

	Disease (+)	Disease (-)
Risk Factor (+)	$x_{++}$	$x_{+-}$
Risk Factor (-)	$x_{-+}$	$x_{--}$

---

BooleanTest-class      *Boolean Test-&-Disease Table*

---

**Description**

Boolean Test-&-Disease Table

**Slots**

.Data two-by-two [integer matrix](#), contingency table of a Boolean test-&-disease decisions with layout

	Disease (+)	Disease (-)
Test (+)	$x_{++}$	$x_{+-}$
Test (-)	$x_{-+}$	$x_{--}$

---

Chapter01

*Chapter 1*

---

**Description**

Functions and examples for Chapter 1, *Introduction to Biostatistics*.

**Usage**

```
sampleRow(x, size, replace = FALSE, prob = NULL)
```

**Arguments**

x	a <a href="#">data.frame</a>
size	positive <a href="#">integer</a> scalar, number of rows to be selected
replace	<a href="#">logical</a> scalar, whether sampling should be with replacement (default FALSE)
prob	<a href="#">numeric</a> vector of probability weights for each row of input x being sampled. Default NULL indicates simple random sampling

**Value**

[sampleRow](#) returns a [data.frame](#), a simple random sample from the input.

**References**

Wayne W. Daniel, *Biostatistics: A Foundation for Analysis in the Health Sciences*, Tenth Edition. Wiley, ISBN: 978-1-119-62550-6.

**See Also**

[sample.int](#)

**Examples**

```
library(DanielBiostatistics10th)
# To run a line of code, use shortcut
# Command + Enter: Mac and RStudio Cloud
# Control + Enter: Windows, Mac and RStudio Cloud
# To clear the console
# Control + L: Mac and RStudio Cloud

# Page 8, Example 1.4.1
class(EXA_C01_S04_01) # `EXA_C01_S04_01` is a 'data.frame' (a specific class defined in R)
dim(EXA_C01_S04_01) # dimension, number-row and number-column
head(EXA_C01_S04_01, n = 8L) # first `n` rows of a 'data.frame'
names(EXA_C01_S04_01) # column names of a 'data.frame'
EXA_C01_S04_01$AGE # use `$` to obtain one column from a 'data.frame'
sampleRow(EXA_C01_S04_01, size = 10L, replace = FALSE) # to answer Example 1.4.1

# Page 11, Example 1.4.2
EXA_C01_S04_01[seq.int(from = 4L, to = 166L, by = 18L), ]
```

**Description**

Functions and examples for Chapter 2, *Descriptive Statistics*.

**Usage**

```
print_stats(x, na.rm = TRUE)
```

```
print_freqs(x, breaks, include.lowest = TRUE, right = TRUE)
```

**Arguments**

x	numeric vector, the observations. In <a href="#">print_freqs</a> function, this argument can also be a <a href="#">factor</a>
na.rm	logical scalar, whether to remove the missing observations (default TRUE)
breaks	numeric vector, see <a href="#">cut.default</a>
include.lowest	logical scalar, default TRUE. See <a href="#">cut.default</a>
right	logical scalar, see <a href="#">cut.default</a>

**Details**

[print\\_freqs](#) prints the (relative) frequencies and cumulative (relative) frequencies, from a numeric input vector, specified interval breaks as well as open/close status of the ends of the intervals.

[print\\_stats](#) prints the simple statistics of the input observations, such as sample size, mean, median, (smallest) mode, variance, standard deviation, coefficient of variation (if all observations are non-negative), quartiles, inter-quartile range (IQR), range, skewness and kurtosis. A histogram is also printed.

**Value**

[print\\_freqs](#) returns a [freqs](#) object, for which a [show](#) method, an [autolayer](#) and an [autoplot](#) method are defined.

[print\\_stats](#) does not have a returned value.

**References**

Wayne W. Daniel, *Biostatistics: A Foundation for Analysis in the Health Sciences*, Tenth Edition. Wiley, ISBN: 978-1-119-62550-6.

**See Also**

[cut.default](#) [table](#) [cumsum](#) [mean.default](#) [median.default](#) [Mode](#) [var](#) [sd](#) [quantile](#) [skewness](#) [kurtosis](#)

**Examples**

```

library(DanielBiostatistics10th)

# Page 20, Example 2.2.1
head(EXA_C01_S04_01)
class(EXA_C01_S04_01$AGE) # 'integer'
class(age <- as.numeric(EXA_C01_S04_01$AGE)) # 'numeric'
sort(age) # Page 21, Table 2.2.1 # 'ordered vector'

# Page 23, Example 2.3.1
(ageB = seq.int(from = 30, to = 90, by = 10))
(r231 = print_freqs(age, breaks = ageB, right = FALSE)) # Page 25, Table 2.3.2
# The open/close of interval ends is determined by textbook using 30-39, 40-49, etc.
autoplot(r231, title = 'Page 27, Figure 2.3.2')

# Page 38-42, Example 2.4.1 - Example 2.4.6
# Page 44-46, Example 2.5.1 - Example 2.5.3
print_stats(age) # or some other data input

# Page 49, Example 2.5.4 (omitted)

# Page 50, Example 2.5.5
head(EXA_C02_S05_05)
boxplot(EXA_C02_S05_05$GRF, main = c('GRF from Page 50, Example 2.5.5'))
print_stats(EXA_C02_S05_05$GRF)
print_freqs(EXA_C02_S05_05$GRF, breaks = seq.int(10, 45, by = 5))

```

Chapter03

Chapter 3

**Description**

Functions for Chapter 3, *Some Basic Probability Concepts*.

**Usage**

```

addProbs(A)

predictiveValues(
  A,
  sensitivity = A[1, 1]/sum(A[, 1]),
  specificity = A[2, 2]/sum(A[, 2]),
  prevalence = stop("must provide prevalence")
)

```

**Arguments**

A [integer matrix](#), two-dimensional contingency table. For [predictiveValues](#) function, this must be a [BooleanTest](#) object, or a two-by-two [integer matrix](#) of the same with layout as outlined in [BooleanTest](#)

sensitivity, specificity      **numeric** scalars, sensitivity and specificity of a test. By default, these are calculated by the test-disease contingency table A

prevalence      **numeric** scalar or vector, prevalence(s) of disease

### Details

[addProbs](#) provides the joint, marginal and conditional probabilities of a contingency table.

[predictiveValues](#) provides the predictive values based on the sensitivity, specificity of a test, as well as the disease prevalence.

### Value

[addProbs](#) returns an [addProbs](#) object, which is a **list** consisting of a **noquote matrix** of joint probabilities, and two **noquote matrix** of conditional probabilities. A **print** method is defined for [addProbs](#) object.

[predictiveValues](#) returns a [predictiveValues](#) object, which is a **list** of three **double** vector elements named 'Prevalence', 'PVP' and 'PVN'. A **print** method and an **autoplot** method are defined for [predictiveValues](#) object.

### References

Wayne W. Daniel, *Biostatistics: A Foundation for Analysis in the Health Sciences*, Tenth Edition. Wiley, ISBN: 978-1-119-62550-6.

### See Also

[addmargins](#) [rowSums](#) [colSums](#) [proportions](#)

### Examples

```
library(DanielBiostatistics10th)

# Page 69-75, Example 3.4.1 - Example 3.4.8
(d341 = matrix(c(28L, 19L, 41L, 53L, 35L, 38L, 44L, 60L), ncol = 2L, dimnames = list(
  FamilyHx = c('none', 'Bipolar', 'Unipolar', 'UniBipolar'),
  Onset = c('Early', 'Late'))))
class(d341) # 'matrix', i.e., a two-dimensional 'array'
addProbs(d341)

# Page 81, Example 3.5.1
(d351 = matrix(c(436L, 14L, 5L, 495L), nrow = 2L, dimnames = list(
  Test = c('Positive', 'Negative'), Alzheimer = c('Yes', 'No'))))
predictiveValues(d351, prevalence = .113)
predictiveValues(d351, prevalence = c(.005, .98))
```

**Description**

Functions for Chapter 4, *Probability Distributions*.

**Usage**

```
binomBar(size, prob, xlim = size, title)
```

```
poisBar(lambda, xlim, title)
```

**Arguments**

size	non-negative <a href="#">integer</a> scalar, number of trials for binomial distribution
prob	<a href="#">numeric</a> scalar between 0 and 1, probability of success on each trial for binomial distribution
xlim	length-two <a href="#">numeric</a> vector, horizontal limit of the figure
title	<a href="#">character</a> scalar, title of the figure
lambda	positive <a href="#">numeric</a> scalar, mean of Poisson distribution

**Details**

[binomBar](#) and [poisBar](#) generate bar plots of binomial and Poisson distributions.

**Value**

[binomBar](#) and [poisBar](#) returns a 'discreteDistBar' object, for which a [print](#) method, an [autolayer](#) and an [autoplot](#) method are defined.

**References**

Wayne W. Daniel, *Biostatistics: A Foundation for Analysis in the Health Sciences*, Tenth Edition. Wiley, ISBN: 978-1-119-62550-6.

**See Also**

[dbinom](#) [dpois](#)

## Examples

```

library(DanielBiostatistics10th)

# Page 93-97, Example 4.2.1 - Example 4.2.7
d421 = rep(1:8, times = c(62L, 47L, 39L, 39L, 58L, 37L, 4L, 11L))
(fq421 = print_freqs(factor(d421))) # Page 94, Table 4.2.1 and 4.2.2; Page 96, Table 4.2.3
autoplot(fq421, type = 'density', title = 'Page 95, Figure 4.2.1')
autoplot(fq421, type = 'distribution', title = 'Page 96, Figure 4.2.2')

# ?dbinom # 'd' for binomial 'density'; calculate Prob(X = x)
# ?pbinom # 'p' for binomial 'probability'
# `lower.tail = TRUE` (default), calculate Prob(X <= x)
# `lower.tail = FALSE`, calculate Prob(X > x)

# Page 99, Example 4.3.1
dbinom(x = 3L, size = 5L, prob = .858)
# Page 103, Example 4.3.2
dbinom(x = 4L, size = 10L, prob = .14)
# Page 103, Example 4.3.3
(pL = pbinom(q = 5L, size = 25L, prob = .1, lower.tail = TRUE)) # (a) including!
(pU = pbinom(q = 5L, size = 25L, prob = .1, lower.tail = FALSE)) # (b) excluding!
pL + pU # R makes sure they add up to 1
binomBar(size = 25L, prob = .1)
# Page 105, Example 4.3.4
dbinom(x = 7L, size = 12L, prob = .55)
pbinom(q = 5L, size = 12L, prob = .55)
pbinom(q = 7L, size = 12L, prob = .55, lower.tail = FALSE)

# Page 110, Example 4.4.1
dpois(x = 3L, lambda = 12)
# Page 110, Example 4.4.2
ppois(2L, lambda = 12, lower.tail = FALSE)
poisBar(lambda = 12, xlim = 30L)
# Page 110, Example 4.4.3
ppois(1L, lambda = 2)
# Page 111, Example 4.4.4
dpois(3L, lambda = 2)
# Page 112, Example 4.4.5
ppois(5L, lambda = 2, lower.tail = FALSE)

# Page 119. Example 4.6.1
pnorm(2)
# Page 120. Example 4.6.2
pnorm(2.55) - pnorm(-2.55)
1 - 2 * pnorm(-2.55) # alternative solution
# Page 121. Example 4.6.3
pnorm(1.53) - pnorm(-2.74)
# Page 121. Example 4.6.4
pnorm(2.71, lower.tail = FALSE)
# Page 122. Example 4.6.5
pnorm(2.45) - pnorm(.84)

```



```
# Page 122. Example 4.7.1
pnorm(q = 3, mean = 5.4, sd = 1.3)
pnorm(q = (3-5.4)/1.3) # manual solution
# Page 125. Example 4.7.2
pnorm(649, mean = 491, sd = 119) - pnorm(292, mean = 491, sd = 119)
# Page 122. Example 4.7.3
1e4L * pnorm(8.5, mean = 5.4, sd = 1.3, lower.tail = FALSE)
```

---

Chapter05to07

Chapter 5, 6 and 7

---

## Description

Functions for Chapter 5, *Some Important Sampling Distributions*, Chapter 6, *Estimation* and Chapter 7, *Hypothesis Testing*.

## Usage

```
aggregated_z(  
  xbar,  
  n,  
  sd,  
  null.value,  
  alternative = c("two.sided", "less", "greater"),  
  conf.level = 0.95,  
  ...  
)
```

```
aggregated_t(  
  xbar,  
  xsd,  
  n,  
  null.value,  
  var.equal = FALSE,  
  alternative = c("two.sided", "less", "greater"),  
  conf.level = 0.95,  
  ...  
)
```

```
prop_CLT(  
  x,  
  n,  
  bool_obs,  
  xbar = x/n,  
  null.value,  
  alternative = c("two.sided", "less", "greater"),  
  conf.level = 0.95,
```

```

    ...
)

aggregated_var(
  xsd,
  n,
  null.value,
  alternative = c("two.sided", "less", "greater"),
  conf.level = 0.95,
  ...
)

```

### Arguments

xbar	<b>numeric</b> scalar or length-two vector. Sample mean(s) for <b>numeric</b> variable(s) $\bar{x}$ or $(\bar{x}_1, \bar{x}_2)$ . Sample proportion(s) for binary (i.e., <b>logical</b> ) variable(s) $\hat{p}$ or $(\hat{p}_1, \hat{p}_2)$ . In the case of two-sample tests, this could also be a <b>numeric</b> scalar indicating the difference in sample means $\bar{x}_1 - \bar{x}_2$ or sample proportions $\hat{p}_1 - \hat{p}_2$
n	<b>integer</b> scalar $n$ or length-two vector. Sample size(s) $n$ or $(n_1, n_2)$
sd	<b>numeric</b> scalar or length-two vector. population standard deviation(s) $\sigma$ or $(\sigma_1, \sigma_2)$
null.value	(optional) <b>numeric</b> scalar or length-two vector. Null value(s) of the population mean(s) $(\mu_0, (\mu_{10}, \mu_{20}),$ or $\mu_{10} - \mu_{20})$ for <a href="#">aggregated_z</a> and <a href="#">aggregated_t</a> . Null value(s) of the population proportion(s) $(p_0, (p_{10}, p_{20}),$ or $p_{10} - p_{20})$ for <a href="#">prop_CLT</a> . Null value(s) of the population variance(s) (ratio) $(\sigma_0^2, (\sigma_{10}^2, \sigma_{20}^2),$ or $\sigma_{10}^2/\sigma_{20}^2)$ for <a href="#">aggregated_var</a> . If missing, only the confidence intervals will be computed.
alternative	<b>character</b> scalar, alternative hypothesis, either 'two.sided' (default), 'greater' or 'less'
conf.level	<b>numeric</b> scalar, confidence level, default 0.95
...	potential arguments, not in use currently
xsd	<b>numeric</b> scalar or length-two vector. Sample standard deviation(s) $\sigma_{\bar{x}}$ or $(\sigma_{\bar{x}_1}, \sigma_{\bar{x}_2})$
var.equal	<b>logical</b> scalar, whether to treat the two population variances as being equal (default FALSE) in <a href="#">aggregated_t</a>
x	<b>integer</b> scalar or length-two vector, number of positive count(s) of binary (i.e., <b>logical</b> ) variable(s)
bool_obs	<b>logical</b> vector of Boolean observations, used in one-sample $z$ -test on proportion

### Details

[aggregated\\_z](#) performs one- or two-sample  $z$ -test using the aggregated statistics of sample mean(s) and sample size(s) when `null.value` is provided. Otherwise, only the confidence interval based on  $z$ -distribution is computed.

[aggregated\\_t](#) performs one- or two-sample  $t$ -test using the aggregated statistics of sample mean(s), sample standard deviation(s) and sample size(s) when `null.value` is provided. Otherwise, only the confidence interval based on  $t$ -distribution is computed.

`prop_CLT` performs one- or two-sample  $z$ -test on proportion(s), using Central Limit Theorem when `null.value` is provided. Otherwise, only the confidence interval based on  $z$ -distribution is computed.

`aggregated_var` performs one-sample  $\chi^2$ -test on variance, or two-sample  $F$ -test on variances, using the aggregated statistics of sample standard deviation(s) and sample size(s) when `null.value` is provided. Otherwise, only the confidence interval based on  $\chi^2$ - or  $F$ -distribution is computed.

## Value

`aggregated_z` returns an 'htest' object when `null.value` is provided, otherwise returns a length-two numeric vector.

`aggregated_t` returns an `htest` object when `null.value` is provided, otherwise returns a length-two numeric vector.

`prop_CLT` returns an `htest` object when `null.value` is provided, otherwise returns a length-two numeric vector.

`aggregated_var` returns an `htest` object when `null.value` is provided, otherwise returns a length-two numeric vector.

## References

Wayne W. Daniel, *Biostatistics: A Foundation for Analysis in the Health Sciences*, Tenth Edition. Wiley, ISBN: 978-1-119-62550-6.

## See Also

[t.test](#) [prop.test](#) [var.test](#)

## Examples

```
library(DanielBiostatistics10th)

# Page 142, Example 5.3.2
aggregated_z(xbar = 190, sd = 12.7, n = 10L, null.value = 185.6, alternative = 'greater')
# Page 143, Example 5.3.3
pnorm(125, mean = 120, sd = 15/sqrt(50)) - pnorm(115, mean = 120, sd = 15/sqrt(50))
aggregated_z(125, sd = 15, n = 50L, null.value = 120, alternative = 'less')$p.value -
  aggregated_z(115, sd = 15, n = 50L, null.value = 120, alternative = 'less')$p.value

# Page 145, Example 5.4.1
aggregated_z(xbar = c(92, 105), sd = 20, n = 15L, null.value = 0, alternative = 'less')
# Page 148, Example 5.4.2
aggregated_z(xbar = 20, sd = c(15, 20), n = c(35L, 40L), null.value = c(45, 30),
  alternative = 'greater')

# Page 150, Example 5.5.1
prop_CLT(xbar = .4, n = 150L, null.value = .357, alternative = 'greater')
# Page 152, Example 5.5.2
prop_CLT(xbar = .45, n = 200L, null.value = .51, alternative = 'less')

# Page 155, Example 5.6.1
```

```

prop_CLT(xbar = .1, null.value = c(.28, .21), n = c(100L, 100L), alternative = 'greater')
# Page 155, Example 5.6.2
prop_CLT(xbar = .05, null.value = c(.34, .26), n = c(250L, 200L), alternative = 'less')

# Page 166, Example 6.2.1
aggregated_z(xbar = 22, n = 10L, sd = sqrt(45))
# Page 168, Example 6.2.2
aggregated_z(xbar = 84.3, n = 15L, sd = sqrt(144), conf.level = .99)
# Page 168, Example 6.2.3
aggregated_z(xbar = 17.2, n = 35L, sd = 8, conf.level = .9)
# Page 169, Example 6.2.4
head(EXA_C06_S02_04)
aggregated_z(xbar = mean(EXA_C06_S02_04$ACTIVITY), n = nrow(EXA_C06_S02_04), sd = sqrt(.36))

# Page 173, Example 6.3.1
aggregated_t(xbar = 250.8, xsd = 130.9, n = 19L)

# Page 177, Example 6.4.1
aggregated_z(xbar = c(4.5, 3.4), sd = sqrt(c(1, 1.5)), n = c(12L, 15L))
# Page 178, Example 6.4.2
aggregated_z(xbar = c(4.3, 13), sd = c(5.22, 8.97), n = c(328L, 64L), conf.level = .99)
# Page 180, Example 6.4.3
aggregated_t(xbar = c(4.7, 8.8), xsd = c(9.3, 11.5), n = c(18L, 10L), var.equal = TRUE)
# Page 181, Example 6.4.4
aggregated_t(xbar = c(4.7, 8.8), xsd = c(9.3, 11.5), n = c(18L, 10L))
# Welch slightly different from Cochran; textbook explained on Page 182

# Page 185, Example 6.5.1
prop_CLT(xbar = .18, n = 1220L)

# Page 187, Example 6.6.1
prop_CLT(x = c(31L, 53L), n = c(68L, 255L), conf.level = .99)

# Page 190, Example 6.7.1
n_671 = uniroot(f = function(n, sd, level = .95) {
  qnorm(1-(1-level)/2) * sd/sqrt(n) - 5 # half-width of CI <= 5 grams
}, interval = c(0, 2e2), sd = 20)
sprintf('Example 6.7.1 requires a sample size of %d.', ceiling(n_671$root))

# Page 192, Example 6.8.1
n_681 = uniroot(f = function(n, p, level = .95) {
  qnorm(1-(1-level)/2) * sqrt(p*(1-p)/n) - .05
}, interval = c(0, 1e3), p = .35)
sprintf('Example 6.8.1 requires a sample size of %d.', ceiling(n_681$root))

# Page 196, Example 6.9.1
d691 = c(9.7, 12.3, 11.2, 5.1, 24.8, 14.8, 17.7)
sqrt(aggregated_var(xsd = sd(d691), n = length(d691)))

# Page 200, Example 6.10.1
aggregated_var(xsd = c(8.1, 5.9), n = c(16L, 4L))

# Page 222, Example 7.2.1

```

```

aggregated_z(xbar = 27, sd = sqrt(20), n = 10L, null.value = 30)
# Page 226, Example 7.2.2
aggregated_z(xbar = 27, sd = sqrt(20), n = 10L, null.value = 30, alternative = 'less')
# Page 228, Example 7.2.3
head(EXA_C07_S02_03)
t.test(EXA_C07_S02_03$DAYS, mu = 15)
# Page 231, Example 7.2.4
aggregated_z(xbar = 146, sd = 27, n = 157L, null.value = 140, alternative = 'greater')
# Page 232, Example 7.2.5
d725 = c(33.38, 32.15, 34.34, 33.95, 33.46, 34.13, 33.99, 34.10, 33.85,
        34.23, 34.45, 34.19, 33.97, 32.73, 34.05)
t.test(d725, mu = 34.5)

# Page 237, Example 7.3.1
aggregated_z(xbar = c(4.5, 3.4), sd = sqrt(c(1, 1.5)), n = c(12L, 15L), null.value = 0)
# Page 239, Example 7.3.2
head(EXA_C07_S03_02)
with(EXA_C07_S03_02, t.test(x = CONTROL, y = SCI, alternative = 'less', var.equal = TRUE))
# Page 240, Example 7.3.3
aggregated_t(xbar = c(19.16, 9.53), xsd = c(5.29, 2.69), n = c(15L, 30L), null.value = 0)
# Page 242, Example 7.3.4
aggregated_z(xbar = c(59.01, 46.61), sd = c(44.89, 34.85), n = c(53L, 54L), null.value = 0,
            alternative = 'greater')

# Page 251, Example 7.4.1
head(EXA_C07_S04_01)
with(EXA_C07_S04_01, t.test(x = POSTOP, y = PREOP, alternative = 'greater', paired = TRUE))

# Page 258, Example 7.5.1
prop_CLT(x = 24L, n = 301L, null.value = .063, alternative = 'greater')

# Page 261, Example 7.6.1
prop_CLT(x = c(24L, 11L), n = c(44L, 29L), null.value = 0, alternative = 'greater')

# Page 264, Example 7.7.1
head(EXA_C07_S07_01)
aggregated_var(xsd = sd(EXA_C07_S07_01$mass), n = 16L, null.value = 600)

# Page 268, Example 7.8.1
aggregated_var(xsd = c(30.62, 11.37), n = 6L, null.value = 1, alternative = 'greater')
# Page 270, Example 7.8.2
with(EXA_C07_S03_02, var.test(x = CONTROL, y = SCI))

```

## Description

Functions for Chapter 7, *Hypothesis Testing*.

**Usage**

```
power_z(
  x,
  null.value,
  sd,
  n,
  std.err = sd/sqrt(n),
  alternative = c("two.sided", "less", "greater"),
  sig.level = 0.05
)
```

**Arguments**

<code>x</code>	<b>numeric</b> vector, mean parameter(s) $\mu_1$ in the alternative hypothesis
<code>null.value</code>	<b>numeric</b> scalar, mean parameter $\mu_0$ in the null hypothesis
<code>sd</code>	<b>numeric</b> scalar, population standard deviation $\sigma$
<code>n</code>	<b>integer</b> scalar, sample size $n$
<code>std.err</code>	<b>numeric</b> scalar, standardized error. For one-sample $z$ -test, this is $\sigma/\sqrt{n}$ . Be aware of the name clash with <code>stderr</code>
<code>alternative</code>	<b>character</b> scalar, alternative hypothesis, either 'two.sided' (default), 'greater' or 'less'
<code>sig.level</code>	<b>numeric</b> scalar, significance level (i.e., Type-I-error rate), default .05

**Details**

`power_z` calculates the powers at each element of the alternative parameters  $\mu_1$ , for one-sample  $z$ -test

- $H_0 : \mu = \mu_0$  vs.  $H_A : \mu \neq \mu_0$ , if `alternative = 'two.sided'`
- $H_0 : \mu \leq \mu_0$  vs.  $H_A : \mu > \mu_0$ , if `alternative = 'greater'`
- $H_0 : \mu \geq \mu_0$  vs.  $H_A : \mu < \mu_0$ , if `alternative = 'less'`

**Value**

`power_z` returns a **power** object, for which a `show` method, an `autolayer` and an `autoplot` method are defined for `power_z` object.

**References**

Wayne W. Daniel, *Biostatistics: A Foundation for Analysis in the Health Sciences*, Tenth Edition. Wiley, ISBN: 978-1-119-62550-6.

**See Also**

[power.t.test](#)

**Examples**

```

library(DanielBiostatistics10th)

# Page 272, Example 7.9.1
(p791 = power_z(seq.int(from = 16, to = 19, by = .5), null.value = 17.5, sd = 3.6, n = 100L))
# Page 275, Table 7.9.1
autoplot(p791, title = 'Page 275, Figure 7.9.2')

# Page 276, Example 7.9.2
(p792 = power_z(seq.int(from = 50, to = 70, by = 5), null.value = 65, sd = 15, n = 20L,
  sig.level = .01, alternative = 'less'))
autoplot(p792, title = 'Page 277, Figure 7.9.4')
autoplot(p792, all.alternative = TRUE, title = '1-sided vs. 2-sided test')

# Page 278, Example 7.10.1
(n_d7101 <- uniroot(f = function(x) {
  power_z(55, null.value = 65, sd = 15, n = x, sig.level = .01, alternative = 'less') - .95
}, interval = c(0, 50))$root)
(C_d7101 = qnorm(p = .01, mean = 65, sd = 15/sqrt(ceiling(n_d7101)), lower.tail = TRUE))

```

**Description**

Functions for Chapter 9, *Simple Linear Regression and Correlation*.

**Usage**

```
predict_lm(object, newx, level = 0.95, ...)
```

**Arguments**

object	lm object, with one and only one <b>numeric</b> predictor
newx	(optional) <b>numeric</b> scalar or vector, new $x$ -value(s) for which the fitted response(s) are to be reported
level	<b>numeric</b> scalar, tolerance/confidence level, default .95
...	potential arguments, not in use currently

**Value**

`predict_lm` returns a `predict_lm` object, for which a `print` method, an `autolayer` and an `autoplot` method are defined.

**References**

Wayne W. Daniel, *Biostatistics: A Foundation for Analysis in the Health Sciences*, Tenth Edition. Wiley, ISBN: 978-1-119-62550-6.

**See Also**[predict.lm](#)**Examples**

```

library(DanielBiostatistics10th)

# Page 417, Example 9.3.1
head(EXA_C09_S03_01)
names(EXA_C09_S03_01)[2:3] = c('Waist', 'AT')
plot(AT ~ Waist, data = EXA_C09_S03_01, xlab = 'Waist circumference (cm), X',
      ylab = 'Deep abdominal AT area (cm2), Y', main = 'Page 419, Figure 9.3.1')

# Page 436, Example 9.4.2
summary(m931 <- lm(AT ~ Waist, data = EXA_C09_S03_01))
cor(EXA_C09_S03_01[2:3]); cor.test(~ AT + Waist, data = EXA_C09_S03_01)
confint(m931) # confidence interval of regression coefficients
anova(m931)

# Page 440, Example 9.4.3
plot(m931, which = 1, main = 'Page 440, Figure 9.4.8')

# Page 441, Section 9.5
autoplot(predict_lm(m931), xlab = 'Waist circumference (cm), X',
          ylab = 'Deep abdominal AT area (cm2), Y',
          title = 'Page 422, Figure 9.3.3; Page 442, Figure 9.5.1')

# Page 447, Example 9.7.1
head(EXA_C09_S07_01)
summary(mod_971 <- lm(CV ~ HEIGHT, data = EXA_C09_S07_01))
autoplot(predict_lm(mod_971), xlab = 'Height (cm)', ylab = 'Cv (units)',
          title = 'Page 449, Figure 9.7.2')

# Page 452, Example 9.7.2
cor(EXA_C09_S07_01); cor.test(~ CV + HEIGHT, data = EXA_C09_S07_01)
# Page 451, Figure 9.7.4, Figure 9.7.5

# Page 453, When the Hypothesized rho Is a Nonzero Value
# R does not have a function to do this

```

**Description**

Functions for Chapter 11, *Regression Analysis: Some Additional Techniques*.



**Usage**

```
predict_glm_binomial(object, newx, level = 0.95, ...)
```

**Arguments**

object	glm object with <a href="#">binomial</a> link function, i.e., a logistic regression model, as well as one and only one <a href="#">numeric</a> predictor
newx	(optional) <a href="#">numeric</a> scalar or vector, new $x$ -value(s) for which the fitted response(s) are to be reported
level	<a href="#">numeric</a> scalar, tolerance/confidence level, default .95
...	potential arguments, not in use currently

**Value**

[predict\\_glm\\_binomial](#) returns a [predict\\_glm\\_binomial](#) object, for which a [print](#) method, an [auto-layer](#) and an [autoplot](#) method are defined.

**References**

Wayne W. Daniel, *Biostatistics: A Foundation for Analysis in the Health Sciences*, Tenth Edition. Wiley, ISBN: 978-1-119-62550-6.

**See Also**

[predict.glm](#)

**Examples**

```
library(DanielBiostatistics10th)
library(car)
library(DescTools)

# Page 540, Example 11.1.1
head(EXA_C11_S01_01)
head(log(EXA_C11_S01_01$conc, base = 10))
head(EXA_C11_S01_01$logConc)

# Page 542, Example 11.1.2
head(EXA_C11_S01_02)
cor.test(~ sbp + weight, data = EXA_C11_S01_02)
cor.test(~ sbp + bmi, data = EXA_C11_S01_02)

# Page 545, Example 11.2.1
head(EXA_C11_S02_01)
d1121 = within(EXA_C11_S02_01, expr = {
  SMOKE = as.logical(SMOKE)
})
xlab1121 = 'Length of gestation (weeks)'; ylab1121 = 'Birth weight (grams)'
car::scatterplot(GRAMS ~ WEEKS | SMOKE, data = d1121, regLine = FALSE, smooth = FALSE,
  xlab = xlab1121, ylab = ylab1121, main = 'Page 547, Figure 11.2.1')
```

```

# Page 547, Figure 11.2.2: main model (without interaction)
summary(m1121_main <- lm(GRAMS ~ WEEKS + SMOKE, data = d1121))
confint(m1121_main)
car::scatterplot(GRAMS ~ WEEKS | SMOKE, data = d1121, regLine = FALSE, smooth = FALSE,
                 xlab = xlab1121, ylab = ylab1121, main = 'Page 548, Figure 11.2.3')
(cf_main = m1121_main$coefficients)
abline(a = cf_main[1L], b = cf_main[2L], col = 'blue') # regression line for non-smoking mothers
abline(a = cf_main[1L] + cf_main[3L], b = cf_main[2L], col = 'magenta')

# Page 551, Example 11.2.3
d1123 = within(EXA_C11_S02_03, expr = {
  METHOD = factor(METHOD, levels = c('C', 'A', 'B')) # textbook designated 'C' as reference level
})
summary(mod_1123 <- lm(EFFECT ~ AGE * METHOD, data = d1123)) # Page 555, Figure 11.2.5
confint(mod_1123)
car::scatterplot(EFFECT ~ AGE | METHOD, data = d1123, smooth = FALSE,
                 xlab = 'Age', ylab = 'Treatment effectiveness', main = 'Page 555, Figure 11.2.6')

# (optional) Page 561, Example 11.3.1
head(EXA_C11_S03_01)
names(EXA_C11_S03_01) = c('JOBPER', 'ASRV', 'ENTH', 'AMB', 'COMM', 'PROB', 'INIT')
summary(mod_1131_raw <- lm(JOBPER ~ ASRV + ENTH + AMB + COMM + PROB + INIT, data = EXA_C11_S03_01))
# summary(mod_1131 <- MASS::stepAIC(mod_1131_raw, direction = 'backward'))
# the stepwise selection criterion used in MINITAB is not necessarily AIC

# Page 572, Example 11.4.1
addmargins(d1141 <- array(c(92L, 21L, 15L, 20L), dim = c(2L, 2L), dimnames = list(
  OCAD = c('Present', 'Absent'), Sex = c('Male', 'Female')))) # Page 572, Table 11.4.2
(d1141a = within(as.data.frame(as.table(d1141)), expr = {
  OCAD = (OCAD == 'Present')
  Sex = factor(Sex, levels = c('Female', 'Male'))
}))
(m1141 = glm(OCAD ~ Sex, family = binomial(link = 'logit'), weights = Freq, data = d1141a))
summary(m1141) # Page 573, Figure 11.4.1
exp(m1141$coefficients[2L]) # exp(beta_M)
exp(confint(m1141)) # confidence interval of exp(beta)
predict(m1141, newdata = data.frame(Sex = setNames(nm = c('Male', 'Female'))), type = 'response')

# Page 573, Example 11.4.2
head(EXA_C11_S04_02)
summary(mod_1142 <- glm(ATT ~ AGE, family = binomial, data = EXA_C11_S04_02))
# .. Page 575, Figure 11.4.2
exp(mod_1142$coefficients[2L])
exp(confint(mod_1142))
car::Anova(mod_1142) # Optional
autoplot(predict_glm_binomial(mod_1142, newx = c(50, 65, 80)), title = 'Page 576, Figure 11.4.3')

# (optional) Page 576, Example 11.4.3
head(REV_C11_24)
summary(glm(ONSET ~ HIAA + TRYPT, family = binomial(link = 'logit'), data = REV_C11_24))
# Page 577, Figure 11.4.4
# Predictor TRYPT should be removed from model due to p-value \approx 1
summary(glm(ONSET ~ HIAA, family = binomial(link = 'logit'), data = REV_C11_24))

```

```
# (optional) Page 578, Example 11.4.4
DescTools::PseudoR2(mod_1142, which = 'CoxSnell')
DescTools::PseudoR2(mod_1142, which = 'Nagelkerke')

# (optional) Page 579, Example 11.4.5 (same as Example 11.4.4)
```

---

Chapter12

*Chapter 12*


---

### Description

Functions for Chapter 12, *The Chi-Square Distribution and The Analysis of Frequencies*.

### Usage

```
relativeRisk(A)

oddsRatio(A)

print_OE(0, prob)
```

### Arguments

A	a <a href="#">BooleanRisk</a> object, or a two-by-two <a href="#">integer matrix</a> of the same with layout as outlined in <a href="#">BooleanRisk</a>
0	<a href="#">integer</a> vector, observed counts
prob	<a href="#">numeric</a> vector, anticipated probability. If missing (default), an uniform distribution across all categories are used.

### Value

[relativeRisk](#) returns a 'logRelativeRisk' object, for which a [vcov](#) method and a [print](#) method are defined.

[oddsRatio](#) returns a 'logOddsRatio' object, for which a [vcov](#) method and a [print](#) method are defined.

[print\\_OE](#) prints a table with observed and expected frequencies, as well as the category-wise  $\chi^2$  statistics. A [double](#) vector of the category-wise  $\chi^2$  statistics is returned invisibly.

### References

Wayne W. Daniel, *Biostatistics: A Foundation for Analysis in the Health Sciences*, Tenth Edition. Wiley, ISBN: 978-1-119-62550-6.

## Examples

```

library(DanielBiostatistics10th)

# Page 605, Example 12.3.1
d1231_b = c(-Inf, seq.int(from = 125, to = 275, by = 25), Inf)
(d1231 = setNames( # Page 605, Table 12.3.1
  c(1L, 3L, 8L, 18L, 6L, 4L, 4L, 3L),
  nm = levels(cut(double(), breaks = d1231_b, right = FALSE, include.lowest = TRUE))))
chi1231 = print_OE(d1231, prob = diff.default(pnorm(q = d1231_b, mean = 198.67, sd = 41.31)))
pchisq(sum(chi1231), df = length(d1231) - 3L, lower.tail = FALSE)
# -3L: three restrictions (explained on Page 608)
# (1) making sum(xo) == sum(xe)
# (2) estimating mean
# (3) estimating sd

# Page 609, Example 12.3.2
# 100 doctors, 25 patients per doctor
d1232 = c(5L, 6L, 8L, 10L, 10L, 15L, 17L, 10L, 10L, 9L, 0L)
o1232 = setNames(c(sum(d1232[1:2]), d1232[-(1:2)]), nm = c('0-1', 2:9, '10 or more'))
(p1232 = sum((0:10) * d1232) / (25 * 100)) # binomial `prob`
chi1232 = print_OE(o1232, prob = c(
  pbinom(1L, size = 25L, prob = p1232),
  dbinom(2:9, size = 25L, prob = p1232),
  pbinom(9, size = 25L, prob = p1232, lower.tail = FALSE)))
pchisq(sum(chi1232), df = length(o1232) - 2L, lower.tail = FALSE)
# -2L: two restrictions (explained on Page 611)
# (1) making sum(o) == sum(e)
# (2) estimating p1232

# Page 611, Example 12.3.3
d1233 = c(5L, 14L, 15L, 23L, 16L, 9L, 3L, 3L, 1L, 1L, 0L)
o_1233 = setNames(c(d1233[1:8], sum(d1233[-(1:8)])), nm = c(0:7, '8 or more'))
p_1233 = c(dpois(0:7, lambda = 3), # lambda = 3 is provided by the textbook
  ppois(7L, lambda = 3, lower.tail = FALSE))
chi1233 = print_OE(o_1233, prob = p_1233)
pchisq(sum(chi1233), df = length(o_1233) - 1L, lower.tail = FALSE)
# -1L: one restrictions
# (1) making sum(xo) == sum(xe)
chisq.test(o_1233, p = p_1233) # equivalent # warning on any(E < 5)

# Page 614, Example 12.3.4
d1234 = c('Dec 05' = 62L, 'Jan 06' = 84L, 'Feb 06' = 17L, 'Mar 06' = 16L, 'Apr 06' = 21L)
chi1234 = print_OE(d1234)
pchisq(sum(chi1234), df = length(d1234) - 1L, lower.tail = FALSE)
chisq.test(d1234) # equivalent

# Page 616, Example 12.3.5
d1235 = c(dominant = 43L, heterozygous = 125L, recessive = 32L)
chi1235 = print_OE(d1235, prob = c(1, 2, 1))
pchisq(sum(chi1235), df = length(d1235) - 1L, lower.tail = FALSE)
chisq.test(d1235, p = c(1, 2, 1), rescale.p = TRUE) # equivalent

```

```

# Page 621, Example 12.4.1
addmargins(d1241 <- array(c(260L, 15L, 7L, 299L, 41L, 14L), dim = c(3L, 2L), dimnames = list(
  Race = c('White', 'Black', 'Other'),
  FolicAcid = c('TRUE', 'FALSE'))))
chisq.test(d1241) # ?stats::chisq.test

# Page 626, Example 12.4.2
addmargins(d1242 <- array(c(131L, 14L, 52L, 36L), dim = c(2L, 2L), dimnames = list(
  Type = c('Faller', 'Non-Faller'),
  LifestyleChange = c('TRUE', 'FALSE'))))
chisq.test(d1242, correct = FALSE)
chisq.test(d1242, correct = TRUE) # Page 627, Yates's Correction

# Page 631, Example 12.5.1
addmargins(d1251 <- array(c(21L, 19L, 75L, 77L), dim = c(2L, 2L), dimnames = list(
  Group = c('Narcoleptic', 'Healthy'),
  Migraine = c('TRUE', 'FALSE'))))
(chisq_1251 = chisq.test(d1251, correct = FALSE))
if (FALSE) {
  # (optional) using test on two proportions
  # only equivalent for 2*2 contingency table
  (clt_1251 = prop_CLT(x = c(21L, 19L), n = 96L, null.value = 0))
  all.equal.numeric(unnamed(clt_1251$statistic^2), unnamed(chisq_1251$statistic))
}

# Page 638, Example 12.6.1
addmargins(d1262 <- array(c(2L, 8L, 7L, 4L), dim = c(2L, 2L), dimnames = list(
  Group = c('PI_Naive', 'PA_Experienced'),
  Regimen2yr = c('TRUE', 'FALSE'))))
fisher.test(d1262)

# Page 644, Example 12.7.1
addmargins(d1271 <- array(c(22L, 18L, 216L, 199L), dim = c(2L, 2L),
  dimnames = list(Exercising = c('Extreme', 'No'), PretermLabor = c('TRUE', 'FALSE'))))
relativeRisk(d1271)
# textbook confidence interval (.65, 1.86) wrong (too many rounding in intermediate steps)

# Page 647, Example 12.7.2
addmargins(d1272 <- array(c(64L, 68L, 342L, 3496L), dim = c(2L, 2L), dimnames = list(
  SmkPregnancy = c('TRUE', 'FALSE'),
  Obesity = c('TRUE', 'FALSE'))))
oddsRatio(d1272)

# Page 650, Example 12.7.3
# Page 652, Example 12.7.4
(d1273 <- array(c(21L, 16L, 11L, 6L, 50L, 18L, 14L, 6L), dim = c(2L, 2L, 2L), dimnames = list(
  HTN = c('Present', 'Absent'), OCAD = c('Cases', 'Controls'),
  Age = c('<=55', '>55'))))
addmargins(d1273, margin = 1:2) # Page 651, Table 12.7.6
mantelhaen.test(d1273)

```

---

EXA\_C01\_S04\_01      *Data of Example 1.4.1*

---

**Description**

EXA\_C01\_S04\_01

**Usage**

EXA\_C01\_S04\_01

**Format**

A [data.frame](#) with 189 rows and 2 columns

---

EXA\_C02\_S05\_05      *Data of Example 2.5.5*

---

**Description**

EXA\_C02\_S05\_05

**Usage**

EXA\_C02\_S05\_05

**Format**

A [data.frame](#) with 20 rows and 1 columns

---

EXA\_C06\_S02\_04      *Data of Example 6.2.4*

---

**Description**

EXA\_C06\_S02\_04

**Usage**

EXA\_C06\_S02\_04

**Format**

A [data.frame](#) with 35 rows and 1 columns

---

EXA\_C07\_S02\_03      *Data of Example 7.2.3*

---

**Description**

EXA\_C07\_S02\_03

**Usage**

EXA\_C07\_S02\_03

**Format**

A [data.frame](#) with 17 rows and 2 columns

---

EXA\_C07\_S03\_02      *Data of Example 7.3.2*

---

**Description**

EXA\_C07\_S03\_02

**Usage**

EXA\_C07\_S03\_02

**Format**

A [data.frame](#) with 10 rows and 2 columns

---

EXA\_C07\_S04\_01      *Data of Example 7.4.1*

---

**Description**

EXA\_C07\_S04\_01

**Usage**

EXA\_C07\_S04\_01

**Format**

A [data.frame](#) with 12 rows and 2 columns

---

EXA\_C07\_S07\_01      *Data of Example 7.7.1*

---

**Description**

EXA\_C07\_S07\_01

**Usage**

EXA\_C07\_S07\_01

**Format**

A [data.frame](#) with 17 rows and 1 columns

---

EXA\_C08\_S02\_01      *Data of Example 8.2.1*

---

**Description**

EXA\_C08\_S02\_01

**Usage**

EXA\_C08\_S02\_01

**Format**

A [data.frame](#) with 144 rows and 2 columns

---

EXA\_C08\_S03\_01      *Data of Example 8.3.1*

---

**Description**

EXA\_C08\_S03\_01

**Usage**

EXA\_C08\_S03\_01

**Format**

A [data.frame](#) with 15 rows and 3 columns



---

EXA_C08_S04_01	<i>Data of Example 8.4.1</i>
----------------	------------------------------

---

**Description**

EXA\_C08\_S04\_01

**Usage**

EXA\_C08\_S04\_01

**Format**A [data.frame](#) with 72 rows and 3 columns

---

EXA_C08_S04_02	<i>Data of Example 8.4.2</i>
----------------	------------------------------

---

**Description**

EXA\_C08\_S04\_02

**Usage**

EXA\_C08\_S04\_02

**Format**A [data.frame](#) with 25 rows and 6 columns

---

EXA_C08_S05_02	<i>Data of Example 8.5.2</i>
----------------	------------------------------

---

**Description**

EXA\_C08\_S05\_02

**Usage**

EXA\_C08\_S05\_02

**Format**A [data.frame](#) with 80 rows and 3 columns

---

EXA\_C09\_S03\_01      *Data of Example 9.3.1*

---

**Description**

EXA\_C09\_S03\_01

**Usage**

EXA\_C09\_S03\_01

**Format**

A [data.frame](#) with 109 rows and 3 columns

---

EXA\_C09\_S07\_01      *Data of Example 9.7.1*

---

**Description**

EXA\_C09\_S07\_01

**Usage**

EXA\_C09\_S07\_01

**Format**

A [data.frame](#) with 155 rows and 2 columns

---

EXA\_C10\_S03\_01      *Data of Example 10.3.1*

---

**Description**

EXA\_C10\_S03\_01

**Usage**

EXA\_C10\_S03\_01

**Format**

A [data.frame](#) with 71 rows and 3 columns

---

EXA\_C10\_S06\_01      *Data of Example 10.6.1*

---

**Description**

EXA\_C10\_S06\_01

**Usage**

EXA\_C10\_S06\_01

**Format**

A [data.frame](#) with 29 rows and 3 columns

---

EXA\_C11\_S01\_01      *Data of Example 11.1.1*

---

**Description**

EXA\_C11\_S01\_01

**Usage**

EXA\_C11\_S01\_01

**Format**

A [data.frame](#) with 25 rows and 3 columns

---

EXA\_C11\_S01\_02      *Data of Example 11.1.2*

---

**Description**

EXA\_C11\_S01\_02

**Usage**

EXA\_C11\_S01\_02

**Format**

A [data.frame](#) with 15 rows and 4 columns

---

EXA\_C11\_S02\_01      *Data of Example 11.2.1*

---

**Description**

EXA\_C11\_S02\_01

**Usage**

EXA\_C11\_S02\_01

**Format**

A [data.frame](#) with 100 rows and 4 columns

---

EXA\_C11\_S02\_03      *Data of Example 11.2.3*

---

**Description**

EXA\_C11\_S02\_03

**Usage**

EXA\_C11\_S02\_03

**Format**

A [data.frame](#) with 36 rows and 3 columns

---

EXA\_C11\_S03\_01      *Data of Example 11.3.1*

---

**Description**

EXA\_C11\_S03\_01

**Usage**

EXA\_C11\_S03\_01

**Format**

A [data.frame](#) with 30 rows and 7 columns

---

EXA_C11_S04_02	<i>Data of Example 11.4.2</i>
----------------	-------------------------------

---

**Description**

EXA\_C11\_S04\_02

**Usage**

EXA\_C11\_S04\_02

**Format**A [data.frame](#) with 184 rows and 2 columns

---

EXA_C11_S05_01	<i>Data of Example 11.5.1</i>
----------------	-------------------------------

---

**Description**

EXA\_C11\_S05\_01

**Usage**

EXA\_C11\_S05\_01

**Format**A [data.frame](#) with 45 rows and 4 columns

---

EXA_C12_S02_03	<i>Data of Example 12.2.3</i>
----------------	-------------------------------

---

**Description**

EXA\_C12\_S02\_03

**Usage**

EXA\_C12\_S02\_03

**Format**A [data.frame](#) with 90 rows and 2 columns

---

EXA\_C13\_S03\_02      *Data of Example 13.3.2*

---

**Description**

EXA\_C13\_S03\_02

**Usage**

EXA\_C13\_S03\_02

**Format**

A [data.frame](#) with 12 rows and 3 columns

---

EXA\_C13\_S05\_01      *Data of Example 13.5.1*

---

**Description**

EXA\_C13\_S05\_01

**Usage**

EXA\_C13\_S05\_01

**Format**

A [data.frame](#) with 16 rows and 2 columns

---

EXA\_C13\_S06\_01      *Data of Example 13.6.1*

---

**Description**

EXA\_C13\_S06\_01

**Usage**

EXA\_C13\_S06\_01

**Format**

A [data.frame](#) with 15 rows and 2 columns

---

EXA\_C13\_S07\_01      *Data of Example 13.7.1*

---

**Description**

EXA\_C13\_S07\_01

**Usage**

EXA\_C13\_S07\_01

**Format**

A [data.frame](#) with 36 rows and 1 columns

---

EXA\_C13\_S08\_02      *Data of Example 13.8.2*

---

**Description**

EXA\_C13\_S08\_02

**Usage**

EXA\_C13\_S08\_02

**Format**

A [data.frame](#) with 10 rows and 5 columns

---

EXA\_C13\_S09\_01      *Data of Example 13.9.1*

---

**Description**

EXA\_C13\_S09\_01

**Usage**

EXA\_C13\_S09\_01

**Format**

A [data.frame](#) with 9 rows and 4 columns

---

EXA\_C13\_S09\_02      *Data of Example 13.9.2*

---

**Description**

EXA\_C13\_S09\_02

**Usage**

EXA\_C13\_S09\_02

**Format**

A [data.frame](#) with 16 rows and 5 columns

---

EXA\_C13\_S10\_01      *Data of Example 13.10.1*

---

**Description**

EXA\_C13\_S10\_01

**Usage**

EXA\_C13\_S10\_01

**Format**

A [data.frame](#) with 20 rows and 3 columns

---

EXA\_C13\_S10\_02      *Data of Example 13.10.2*

---

**Description**

EXA\_C13\_S10\_02

**Usage**

EXA\_C13\_S10\_02

**Format**

A [data.frame](#) with 35 rows and 3 columns



---

EXA\_C14\_S03\_01      *Data of Example 14.3.1*

---

**Description**

EXA\_C14\_S03\_01

**Usage**

EXA\_C14\_S03\_01

**Format**

A [data.frame](#) with 39 rows and 4 columns

---

EXA\_C14\_S05\_01      *Data of Example 14.5.1*

---

**Description**

EXA\_C14\_S05\_01

**Usage**

EXA\_C14\_S05\_01

**Format**

A [data.frame](#) with 40 rows and 5 columns

---

EXR\_C02\_S03\_01      *Data of Exercise 2.3.1*

---

**Description**

EXR\_C02\_S03\_01

**Usage**

EXR\_C02\_S03\_01

**Format**

A [data.frame](#) with 90 rows and 1 columns

---

EXR\_C02\_S03\_02      *Data of Exercise 2.3.2*

---

**Description**

EXR\_C02\_S03\_02

**Usage**

EXR\_C02\_S03\_02

**Format**

A [data.frame](#) with 159 rows and 1 columns

---

EXR\_C02\_S03\_03      *Data of Exercise 2.3.3*

---

**Description**

EXR\_C02\_S03\_03

**Usage**

EXR\_C02\_S03\_03

**Format**

A [data.frame](#) with 29 rows and 1 columns

---

EXR\_C02\_S03\_04      *Data of Exercise 2.3.4*

---

**Description**

EXR\_C02\_S03\_04

**Usage**

EXR\_C02\_S03\_04

**Format**

A [data.frame](#) with 53 rows and 1 columns

---

EXR\_C02\_S03\_05      *Data of Exercise 2.3.5*

---

**Description**

EXR\_C02\_S03\_05

**Usage**

EXR\_C02\_S03\_05

**Format**

A [data.frame](#) with 45 rows and 1 columns

---

EXR\_C02\_S03\_06      *Data of Exercise 2.3.6*

---

**Description**

EXR\_C02\_S03\_06

**Usage**

EXR\_C02\_S03\_06

**Format**

A [data.frame](#) with 60 rows and 1 columns

---

EXR\_C02\_S03\_07      *Data of Exercise 2.3.7*

---

**Description**

EXR\_C02\_S03\_07

**Usage**

EXR\_C02\_S03\_07

**Format**

A [data.frame](#) with 155 rows and 1 columns

---

EXR\_C02\_S03\_08      *Data of Exercise 2.3.8*

---

**Description**

EXR\_C02\_S03\_08

**Usage**

EXR\_C02\_S03\_08

**Format**

A [data.frame](#) with 30 rows and 1 columns

---

EXR\_C02\_S03\_09      *Data of Exercise 2.3.9*

---

**Description**

EXR\_C02\_S03\_09

**Usage**

EXR\_C02\_S03\_09

**Format**

A [data.frame](#) with 50 rows and 2 columns

---

EXR\_C02\_S03\_11      *Data of Exercise 2.3.11*

---

**Description**

EXR\_C02\_S03\_11

**Usage**

EXR\_C02\_S03\_11

**Format**

A [data.frame](#) with 216 rows and 1 columns

---

EXR\_C02\_S03\_12      *Data of Exercise 2.3.12*

---

**Description**

EXR\_C02\_S03\_12

**Usage**

EXR\_C02\_S03\_12

**Format**

A [data.frame](#) with 109 rows and 1 columns

---

EXR\_C02\_S05\_03      *Data of Exercise 2.5.3*

---

**Description**

EXR\_C02\_S05\_03

**Usage**

EXR\_C02\_S05\_03

**Format**

A [data.frame](#) with 30 rows and 1 columns

---

EXR\_C02\_S05\_06      *Data of Exercise 2.5.6*

---

**Description**

EXR\_C02\_S05\_06

**Usage**

EXR\_C02\_S05\_06

**Format**

A [data.frame](#) with 20 rows and 1 columns

---

EXR\_C06\_S02\_05      *Data of Exercise 6.2.5*

---

**Description**

EXR\_C06\_S02\_05

**Usage**

EXR\_C06\_S02\_05

**Format**

A [data.frame](#) with 16 rows and 1 columns

---

EXR\_C06\_S04\_10      *Data of Exercise 6.4.10*

---

**Description**

EXR\_C06\_S04\_10

**Usage**

EXR\_C06\_S04\_10

**Format**

A [data.frame](#) with 32 rows and 2 columns

---

EXR\_C06\_S09\_07      *Data of Exercise 6.9.7*

---

**Description**

EXR\_C06\_S09\_07

**Usage**

EXR\_C06\_S09\_07

**Format**

A [data.frame](#) with 20 rows and 1 columns

---

EXR\_C06\_S10\_07      *Data of Exercise 6.10.7*

---

**Description**

EXR\_C06\_S10\_07

**Usage**

EXR\_C06\_S10\_07

**Format**

A [data.frame](#) with 26 rows and 2 columns

---

EXR\_C07\_S02\_13      *Data of Exercise 7.2.13*

---

**Description**

EXR\_C07\_S02\_13

**Usage**

EXR\_C07\_S02\_13

**Format**

A [data.frame](#) with 20 rows and 1 columns

---

EXR\_C07\_S02\_15      *Data of Exercise 7.2.15*

---

**Description**

EXR\_C07\_S02\_15

**Usage**

EXR\_C07\_S02\_15

**Format**

A [data.frame](#) with 50 rows and 1 columns

---

EXR\_C07\_S02\_16      *Data of Exercise 7.2.16*

---

**Description**

EXR\_C07\_S02\_16

**Usage**

EXR\_C07\_S02\_16

**Format**

A [data.frame](#) with 21 rows and 1 columns

---

EXR\_C07\_S03\_03      *Data of Exercise 7.3.3*

---

**Description**

EXR\_C07\_S03\_03

**Usage**

EXR\_C07\_S03\_03

**Format**

A [data.frame](#) with 63 rows and 2 columns

---

EXR\_C07\_S03\_04      *Data of Exercise 7.3.4*

---

**Description**

EXR\_C07\_S03\_04

**Usage**

EXR\_C07\_S03\_04

**Format**

A [data.frame](#) with 174 rows and 2 columns



---

EXR\_C07\_S03\_05      *Data of Exercise 7.3.5*

---

**Description**

EXR\_C07\_S03\_05

**Usage**

EXR\_C07\_S03\_05

**Format**

A [data.frame](#) with 82 rows and 2 columns

---

EXR\_C07\_S03\_10      *Data of Exercise 7.3.10*

---

**Description**

EXR\_C07\_S03\_10

**Usage**

EXR\_C07\_S03\_10

**Format**

A [data.frame](#) with 24 rows and 2 columns

---

EXR\_C07\_S03\_11      *Data of Exercise 7.3.11*

---

**Description**

EXR\_C07\_S03\_11

**Usage**

EXR\_C07\_S03\_11

**Format**

A [data.frame](#) with 20 rows and 2 columns

---

EXR\_C07\_S03\_12      *Data of Exercise 7.3.12*

---

**Description**

EXR\_C07\_S03\_12

**Usage**

EXR\_C07\_S03\_12

**Format**

A [data.frame](#) with 90 rows and 2 columns

---

EXR\_C07\_S04\_01      *Data of Exercise 7.4.1*

---

**Description**

EXR\_C07\_S04\_01

**Usage**

EXR\_C07\_S04\_01

**Format**

A [data.frame](#) with 15 rows and 2 columns

---

EXR\_C07\_S04\_02      *Data of Exercise 7.4.2*

---

**Description**

EXR\_C07\_S04\_02

**Usage**

EXR\_C07\_S04\_02

**Format**

A [data.frame](#) with 66 rows and 2 columns

---

EXR\_C07\_S04\_03      *Data of Exercise 7.4.3*

---

**Description**

EXR\_C07\_S04\_03

**Usage**

EXR\_C07\_S04\_03

**Format**

A [data.frame](#) with 11 rows and 2 columns

---

EXR\_C07\_S04\_04      *Data of Exercise 7.4.4*

---

**Description**

EXR\_C07\_S04\_04

**Usage**

EXR\_C07\_S04\_04

**Format**

A [data.frame](#) with 20 rows and 2 columns

---

EXR\_C07\_S08\_07      *Data of Exercise 7.8.7*

---

**Description**

EXR\_C07\_S08\_07

**Usage**

EXR\_C07\_S08\_07

**Format**

A [data.frame](#) with 23 rows and 2 columns

---

EXR\_C08\_S02\_01      *Data of Exercise 8.2.1*

---

**Description**

EXR\_C08\_S02\_01

**Usage**

EXR\_C08\_S02\_01

**Format**

A [data.frame](#) with 329 rows and 2 columns

---

EXR\_C08\_S02\_02      *Data of Exercise 8.2.2*

---

**Description**

EXR\_C08\_S02\_02

**Usage**

EXR\_C08\_S02\_02

**Format**

A [data.frame](#) with 96 rows and 2 columns

---

EXR\_C08\_S02\_03      *Data of Exercise 8.2.3*

---

**Description**

EXR\_C08\_S02\_03

**Usage**

EXR\_C08\_S02\_03

**Format**

A [data.frame](#) with 113 rows and 2 columns

---

EXR\_C08\_S02\_04      *Data of Exercise 8.2.4*

---

**Description**

EXR\_C08\_S02\_04

**Usage**

EXR\_C08\_S02\_04

**Format**

A [data.frame](#) with 164 rows and 2 columns

---

EXR\_C08\_S02\_05      *Data of Exercise 8.2.5*

---

**Description**

EXR\_C08\_S02\_05

**Usage**

EXR\_C08\_S02\_05

**Format**

A [data.frame](#) with 29 rows and 2 columns

---

EXR\_C08\_S02\_06      *Data of Exercise 8.2.6*

---

**Description**

EXR\_C08\_S02\_06

**Usage**

EXR\_C08\_S02\_06

**Format**

A [data.frame](#) with 90 rows and 2 columns

---

EXR\_C08\_S02\_07      *Data of Exercise 8.2.7*

---

**Description**

EXR\_C08\_S02\_07

**Usage**

EXR\_C08\_S02\_07

**Format**

A [data.frame](#) with 178 rows and 2 columns

---

EXR\_C08\_S03\_01      *Data of Exercise 8.3.1*

---

**Description**

EXR\_C08\_S03\_01

**Usage**

EXR\_C08\_S03\_01

**Format**

A [data.frame](#) with 96 rows and 3 columns

---

EXR\_C08\_S03\_02      *Data of Exercise 8.3.2*

---

**Description**

EXR\_C08\_S03\_02

**Usage**

EXR\_C08\_S03\_02

**Format**

A [data.frame](#) with 10 rows and 5 columns

---

EXR\_C08\_S03\_03      *Data of Exercise 8.3.3*

---

**Description**

EXR\_C08\_S03\_03

**Usage**

EXR\_C08\_S03\_03

**Format**

A [data.frame](#) with 20 rows and 3 columns

---

EXR\_C08\_S03\_04      *Data of Exercise 8.3.4*

---

**Description**

EXR\_C08\_S03\_04

**Usage**

EXR\_C08\_S03\_04

**Format**

A [data.frame](#) with 16 rows and 3 columns

---

EXR\_C08\_S03\_05      *Data of Exercise 8.3.5*

---

**Description**

EXR\_C08\_S03\_05

**Usage**

EXR\_C08\_S03\_05

**Format**

A [data.frame](#) with 12 rows and 3 columns

---

EXR\_C08\_S04\_01      *Data of Exercise 8.4.1*

---

**Description**

EXR\_C08\_S04\_01

**Usage**

EXR\_C08\_S04\_01

**Format**

A [data.frame](#) with 40 rows and 3 columns

---

EXR\_C08\_S04\_02      *Data of Exercise 8.4.2*

---

**Description**

EXR\_C08\_S04\_02

**Usage**

EXR\_C08\_S04\_02

**Format**

A [data.frame](#) with 35 rows and 3 columns

---

EXR\_C08\_S04\_03      *Data of Exercise 8.4.3*

---

**Description**

EXR\_C08\_S04\_03

**Usage**

EXR\_C08\_S04\_03

**Format**

A [data.frame](#) with 48 rows and 3 columns



---

EXR\_C08\_S04\_06      *Data of Exercise 8.4.6*

---

**Description**

EXR\_C08\_S04\_06

**Usage**

EXR\_C08\_S04\_06

**Format**

A [data.frame](#) with 20 rows and 6 columns

---

EXR\_C08\_S05\_01      *Data of Exercise 8.5.1*

---

**Description**

EXR\_C08\_S05\_01

**Usage**

EXR\_C08\_S05\_01

**Format**

A [data.frame](#) with 24 rows and 3 columns

---

EXR\_C08\_S05\_02      *Data of Exercise 8.5.2*

---

**Description**

EXR\_C08\_S05\_02

**Usage**

EXR\_C08\_S05\_02

**Format**

A [data.frame](#) with 72 rows and 3 columns

---

EXR\_C08\_S05\_03      *Data of Exercise 8.5.3*

---

**Description**

EXR\_C08\_S05\_03

**Usage**

EXR\_C08\_S05\_03

**Format**

A [data.frame](#) with 44 rows and 3 columns

---

EXR\_C08\_S05\_04      *Data of Exercise 8.5.4*

---

**Description**

EXR\_C08\_S05\_04

**Usage**

EXR\_C08\_S05\_04

**Format**

A [data.frame](#) with 13 rows and 3 columns

---

EXR\_C09\_S03\_02      *Data of Exercise 9.3.2*

---

**Description**

EXR\_C09\_S03\_02

**Usage**

EXR\_C09\_S03\_02

**Format**

A [data.frame](#) with 10 rows and 2 columns

---

EXR\_C09\_S03\_03      *Data of Exercise 9.3.3*

---

**Description**

EXR\_C09\_S03\_03

**Usage**

EXR\_C09\_S03\_03

**Format**

A [data.frame](#) with 17 rows and 2 columns

---

EXR\_C09\_S03\_04      *Data of Exercise 9.3.4*

---

**Description**

EXR\_C09\_S03\_04

**Usage**

EXR\_C09\_S03\_04

**Format**

A [data.frame](#) with 90 rows and 2 columns

---

EXR\_C09\_S03\_06      *Data of Exercise 9.3.6*

---

**Description**

EXR\_C09\_S03\_06

**Usage**

EXR\_C09\_S03\_06

**Format**

A [data.frame](#) with 22 rows and 2 columns

---

EXR\_C09\_S03\_07      *Data of Exercise 9.3.7*

---

**Description**

EXR\_C09\_S03\_07

**Usage**

EXR\_C09\_S03\_07

**Format**

A [data.frame](#) with 27 rows and 2 columns

---

EXR\_C09\_S07\_01      *Data of Exercise 9.7.1*

---

**Description**

EXR\_C09\_S07\_01

**Usage**

EXR\_C09\_S07\_01

**Format**

A [data.frame](#) with 20 rows and 2 columns

---

EXR\_C09\_S07\_02      *Data of Exercise 9.7.2*

---

**Description**

EXR\_C09\_S07\_02

**Usage**

EXR\_C09\_S07\_02

**Format**

A [data.frame](#) with 90 rows and 2 columns

---

EXR\_C09\_S07\_04      *Data of Exercise 9.7.4*

---

**Description**

EXR\_C09\_S07\_04

**Usage**

EXR\_C09\_S07\_04

**Format**

A [data.frame](#) with 18 rows and 2 columns

---

EXR\_C09\_S07\_05      *Data of Exercise 9.7.5*

---

**Description**

EXR\_C09\_S07\_05

**Usage**

EXR\_C09\_S07\_05

**Format**

A [data.frame](#) with 30 rows and 2 columns

---

EXR\_C09\_S07\_06      *Data of Exercise 9.7.6*

---

**Description**

EXR\_C09\_S07\_06

**Usage**

EXR\_C09\_S07\_06

**Format**

A [data.frame](#) with 15 rows and 2 columns

---

EXR\_C10\_S03\_01      *Data of Exercise 10.3.1*

---

**Description**

EXR\_C10\_S03\_01

**Usage**

EXR\_C10\_S03\_01

**Format**

A [data.frame](#) with 35 rows and 3 columns

---

EXR\_C10\_S03\_02      *Data of Exercise 10.3.2*

---

**Description**

EXR\_C10\_S03\_02

**Usage**

EXR\_C10\_S03\_02

**Format**

A [data.frame](#) with 100 rows and 4 columns

---

EXR\_C10\_S03\_03      *Data of Exercise 10.3.3*

---

**Description**

EXR\_C10\_S03\_03

**Usage**

EXR\_C10\_S03\_03

**Format**

A [data.frame](#) with 10 rows and 3 columns

---

EXR\_C10\_S03\_04      *Data of Exercise 10.3.4*

---

**Description**

EXR\_C10\_S03\_04

**Usage**

EXR\_C10\_S03\_04

**Format**

A [data.frame](#) with 20 rows and 3 columns

---

EXR\_C10\_S03\_05      *Data of Exercise 10.3.5*

---

**Description**

EXR\_C10\_S03\_05

**Usage**

EXR\_C10\_S03\_05

**Format**

A [data.frame](#) with 25 rows and 3 columns

---

EXR\_C10\_S03\_06      *Data of Exercise 10.3.6*

---

**Description**

EXR\_C10\_S03\_06

**Usage**

EXR\_C10\_S03\_06

**Format**

A [data.frame](#) with 20 rows and 8 columns

---

EXR\_C10\_S06\_01      *Data of Exercise 10.6.1*

---

**Description**

EXR\_C10\_S06\_01

**Usage**

EXR\_C10\_S06\_01

**Format**

A [data.frame](#) with 40 rows and 4 columns

---

EXR\_C10\_S06\_02      *Data of Exercise 10.6.2*

---

**Description**

EXR\_C10\_S06\_02

**Usage**

EXR\_C10\_S06\_02

**Format**

A [data.frame](#) with 12 rows and 3 columns

---

EXR\_C10\_S06\_03      *Data of Exercise 10.6.3*

---

**Description**

EXR\_C10\_S06\_03

**Usage**

EXR\_C10\_S06\_03

**Format**

A [data.frame](#) with 15 rows and 3 columns



---

EXR_C10_S06_04	<i>Data of Exercise 10.6.4</i>
----------------	--------------------------------

---

**Description**

EXR\_C10\_S06\_04

**Usage**

EXR\_C10\_S06\_04

**Format**A [data.frame](#) with 15 rows and 6 columns

---

EXR_C11_S02_01	<i>Data of Exercise 11.2.1</i>
----------------	--------------------------------

---

**Description**

EXR\_C11\_S02\_01

**Usage**

EXR\_C11\_S02\_01

**Format**A [data.frame](#) with 44 rows and 3 columns

---

EXR_C11_S02_02	<i>Data of Exercise 11.2.2</i>
----------------	--------------------------------

---

**Description**

EXR\_C11\_S02\_02

**Usage**

EXR\_C11\_S02\_02

**Format**A [data.frame](#) with 100 rows and 3 columns

---

EXR\_C11\_S02\_03      *Data of Exercise 11.2.3*

---

**Description**

EXR\_C11\_S02\_03

**Usage**

EXR\_C11\_S02\_03

**Format**

A [data.frame](#) with 17 rows and 3 columns

---

EXR\_C11\_S02\_04      *Data of Exercise 11.2.4*

---

**Description**

EXR\_C11\_S02\_04

**Usage**

EXR\_C11\_S02\_04

**Format**

A [data.frame](#) with 90 rows and 3 columns

---

EXR\_C11\_S03\_01      *Data of Exercise 11.3.1*

---

**Description**

EXR\_C11\_S03\_01

**Usage**

EXR\_C11\_S03\_01

**Format**

A [data.frame](#) with 100 rows and 8 columns

---

EXR\_C11\_S03\_02      *Data of Exercise 11.3.2*

---

**Description**

EXR\_C11\_S03\_02

**Usage**

EXR\_C11\_S03\_02

**Format**

A [data.frame](#) with 35 rows and 7 columns

---

EXR\_C11\_S03\_03      *Data of Exercise 11.3.3*

---

**Description**

EXR\_C11\_S03\_03

**Usage**

EXR\_C11\_S03\_03

**Format**

A [data.frame](#) with 68 rows and 7 columns

---

EXR\_C11\_S04\_01      *Data of Exercise 11.4.1*

---

**Description**

EXR\_C11\_S04\_01

**Usage**

EXR\_C11\_S04\_01

**Format**

A [data.frame](#) with 4 rows and 3 columns

---

EXR\_C11\_S04\_02      *Data of Exercise 11.4.2*

---

**Description**

EXR\_C11\_S04\_02

**Usage**

EXR\_C11\_S04\_02

**Format**

A [data.frame](#) with 184 rows and 2 columns

---

EXR\_C11\_S05\_01      *Data of Exercise 11.5.1*

---

**Description**

EXR\_C11\_S05\_01

**Usage**

EXR\_C11\_S05\_01

**Format**

A [data.frame](#) with 45 rows and 4 columns

---

EXR\_C11\_S05\_02      *Data of Exercise 11.5.2*

---

**Description**

EXR\_C11\_S05\_02

**Usage**

EXR\_C11\_S05\_02

**Format**

A [data.frame](#) with 45 rows and 5 columns

---

EXR_C11_S05_04	<i>Data of Exercise 11.5.4</i>
----------------	--------------------------------

---

**Description**

EXR\_C11\_S05\_04

**Usage**

EXR\_C11\_S05\_04

**Format**A [data.frame](#) with 90 rows and 3 columns

---

EXR_C13_S05_01	<i>Data of Exercise 13.5.1</i>
----------------	--------------------------------

---

**Description**

EXR\_C13\_S05\_01

**Usage**

EXR\_C13\_S05\_01

**Format**A [data.frame](#) with 30 rows and 2 columns

---

EXR_C13_S05_02	<i>Data of Exercise 13.5.2</i>
----------------	--------------------------------

---

**Description**

EXR\_C13\_S05\_02

**Usage**

EXR\_C13\_S05\_02

**Format**A [data.frame](#) with 30 rows and 2 columns

---

EXR\_C13\_S06\_01      *Data of Exercise 13.6.1*

---

**Description**

EXR\_C13\_S06\_01

**Usage**

EXR\_C13\_S06\_01

**Format**

A [data.frame](#) with 70 rows and 2 columns

---

EXR\_C13\_S06\_02      *Data of Exercise 13.6.2*

---

**Description**

EXR\_C13\_S06\_02

**Usage**

EXR\_C13\_S06\_02

**Format**

A [data.frame](#) with 17 rows and 2 columns

---

EXR\_C13\_S06\_03      *Data of Exercise 13.6.3*

---

**Description**

EXR\_C13\_S06\_03

**Usage**

EXR\_C13\_S06\_03

**Format**

A [data.frame](#) with 83 rows and 2 columns

---

EXR\_C13\_S07\_02      *Data of Exercise 13.7.2*

---

**Description**

EXR\_C13\_S07\_02

**Usage**

EXR\_C13\_S07\_02

**Format**

A [data.frame](#) with 30 rows and 1 columns

---

EXR\_C13\_S08\_01      *Data of Exercise 13.8.1*

---

**Description**

EXR\_C13\_S08\_01

**Usage**

EXR\_C13\_S08\_01

**Format**

A [data.frame](#) with 232 rows and 2 columns

---

EXR\_C13\_S08\_02      *Data of Exercise 13.8.2*

---

**Description**

EXR\_C13\_S08\_02

**Usage**

EXR\_C13\_S08\_02

**Format**

A [data.frame](#) with 15 rows and 2 columns

---

EXR\_C13\_S08\_03      *Data of Exercise 13.8.3*

---

**Description**

EXR\_C13\_S08\_03

**Usage**

EXR\_C13\_S08\_03

**Format**

A [data.frame](#) with 53 rows and 2 columns

---

EXR\_C13\_S08\_04      *Data of Exercise 13.8.4*

---

**Description**

EXR\_C13\_S08\_04

**Usage**

EXR\_C13\_S08\_04

**Format**

A [data.frame](#) with 22 rows and 2 columns

---

EXR\_C13\_S08\_05      *Data of Exercise 13.8.5*

---

**Description**

EXR\_C13\_S08\_05

**Usage**

EXR\_C13\_S08\_05

**Format**

A [data.frame](#) with 44 rows and 2 columns



---

EXR_C13_S08_06	<i>Data of Exercise 13.8.6</i>
----------------	--------------------------------

---

**Description**

EXR\_C13\_S08\_06

**Usage**

EXR\_C13\_S08\_06

**Format**A [data.frame](#) with 22 rows and 3 columns

---

EXR_C13_S09_01	<i>Data of Exercise 13.9.1</i>
----------------	--------------------------------

---

**Description**

EXR\_C13\_S09\_01

**Usage**

EXR\_C13\_S09\_01

**Format**A [data.frame](#) with 9 rows and 4 columns

---

EXR_C13_S09_02	<i>Data of Exercise 13.9.2</i>
----------------	--------------------------------

---

**Description**

EXR\_C13\_S09\_02

**Usage**

EXR\_C13\_S09\_02

**Format**A [data.frame](#) with 15 rows and 11 columns

---

EXR\_C13\_S09\_03      *Data of Exercise 13.9.3*

---

**Description**

EXR\_C13\_S09\_03

**Usage**

EXR\_C13\_S09\_03

**Format**

A [data.frame](#) with 10 rows and 6 columns

---

EXR\_C13\_S10\_01      *Data of Exercise 13.10.1*

---

**Description**

EXR\_C13\_S10\_01

**Usage**

EXR\_C13\_S10\_01

**Format**

A [data.frame](#) with 15 rows and 3 columns

---

EXR\_C13\_S10\_02      *Data of Exercise 13.10.2*

---

**Description**

EXR\_C13\_S10\_02

**Usage**

EXR\_C13\_S10\_02

**Format**

A [data.frame](#) with 10 rows and 3 columns

---

EXR\_C13\_S10\_03      *Data of Exercise 13.10.3*

---

**Description**

EXR\_C13\_S10\_03

**Usage**

EXR\_C13\_S10\_03

**Format**

A [data.frame](#) with 20 rows and 2 columns

---

EXR\_C13\_S10\_04      *Data of Exercise 13.10.4*

---

**Description**

EXR\_C13\_S10\_04

**Usage**

EXR\_C13\_S10\_04

**Format**

A [data.frame](#) with 20 rows and 2 columns

---

EXR\_C13\_S10\_05      *Data of Exercise 13.10.5*

---

**Description**

EXR\_C13\_S10\_05

**Usage**

EXR\_C13\_S10\_05

**Format**

A [data.frame](#) with 30 rows and 2 columns

---

EXR\_C13\_S10\_06      *Data of Exercise 13.10.6*

---

**Description**

EXR\_C13\_S10\_06

**Usage**

EXR\_C13\_S10\_06

**Format**

A [data.frame](#) with 17 rows and 3 columns

---

EXR\_C14\_S03\_01      *Data of Exercise 14.3.1*

---

**Description**

EXR\_C14\_S03\_01

**Usage**

EXR\_C14\_S03\_01

**Format**

A [data.frame](#) with 53 rows and 3 columns

---

EXR\_C14\_S03\_02      *Data of Exercise 14.3.2*

---

**Description**

EXR\_C14\_S03\_02

**Usage**

EXR\_C14\_S03\_02

**Format**

A [data.frame](#) with 62 rows and 2 columns

---

EXR_C14_S04_03	<i>Data of Exercise 14.4.3</i>
----------------	--------------------------------

---

**Description**

EXR\_C14\_S04\_03

**Usage**

EXR\_C14\_S04\_03

**Format**A [data.frame](#) with 50 rows and 4 columns

---

freqs-class	<i>S4 Class <a href="#">freqs</a></i>
-------------	---------------------------------------

---

**Description**S4 Class [freqs](#)**Slots**.Data [integer](#) vector, frequency countsdata.name [character](#) integer, name of the data, only used in output

---

Gosset_Welch	<i>Two-Sample Student's <math>t</math>-statistic and Welch–Satterthwaite Equation</i>
--------------	---

---

**Description**To determine the degree of freedom, as well as the standard error, of two-sample  $t$ -statistic, with or without the equal-variance assumption.**Usage**

Gosset\_Welch(s1, s2, v1 = s1^2, v2 = s2^2, n1, n2, var.equal = FALSE)

**Arguments**

`s1`, `s2` (optional) **double** vectors, sample standard deviations of the two samples  
`v1`, `v2` **double** vectors, sample variances of the two samples, default  $v_1 = s_1^2$ ,  $v_2 = s_2^2$ .  
`n1`, `n2` **integer** vectors, sample sizes of the two samples  
`var.equal` **logical** scalar, whether to treat the two variances as being equal when calculating the degree of freedom and the standard error of the mean-difference. If FALSE (default), Welch–Satterthwaite equation is used. If TRUE, the original two-sample *t*-test from William Sealy Gosset is used.

**Value**

`Gosset_Welch` returns a **numeric** scalar of the degree of freedom, with a **numeric** scalar attribute 'std.err' of the standard error of the mean-difference.

**References**

Student's *t*-test by William Sealy Gosset, [doi:10.1093/biomet/6.1.1](https://doi.org/10.1093/biomet/6.1.1).  
 Welch–Satterthwaite equation by Bernard Lewis Welch and F. E. Satterthwaite [doi:10.2307/3002019](https://doi.org/10.2307/3002019) and [doi:10.1093/biomet/34.12.28](https://doi.org/10.1093/biomet/34.12.28).

**See Also**

[t.test](#)

**Examples**

```
x = rnorm(32L, sd = 1.6); y = rnorm(57L, sd = 2.1)
vx = var(x); vy = var(y); nx = length(x); ny = length(y)
t.test(x, y, var.equal = FALSE)[c('parameter', 'stderr')]
Gosset_Welch(v1 = vx, v2 = vy, n1 = nx, n2 = ny, var.equal = FALSE)
t.test(x, y, var.equal = TRUE)[c('parameter', 'stderr')]
Gosset_Welch(v1 = vx, v2 = vy, n1 = nx, n2 = ny, var.equal = TRUE)
```

**Description**

LDS\_C02\_NCBIRTH800

**Usage**

LDS\_C02\_NCBIRTH800

**Format**

A [data.frame](#) with 800 rows and 14 columns

---

LDS\_C06\_BABYWGTS      *Large Data BABYWGTS from Chapter 6*

---

**Description**

LDS\_C06\_BABYWGTS

**Usage**

LDS\_C06\_BABYWGTS

**Format**

A [data.frame](#) with 1200 rows and 2 columns

---

LDS\_C06\_BOYHGTS      *Large Data BOYHGTS from Chapter 6*

---

**Description**

LDS\_C06\_BOYHGTS

**Usage**

LDS\_C06\_BOYHGTS

**Format**

A [data.frame](#) with 1000 rows and 2 columns

---

LDS\_C06\_CHOLEST      *Large Data CHOLEST from Chapter 6*

---

**Description**

LDS\_C06\_CHOLEST

**Usage**

LDS\_C06\_CHOLEST

**Format**

A [data.frame](#) with 1000 rows and 2 columns

---

LDS\_C07\_HEADCIRC      *Large Data HEADCIRC from Chapter 7*

---

**Description**

LDS\_C07\_HEADCIRC

**Usage**

LDS\_C07\_HEADCIRC

**Format**

A [data.frame](#) with 1000 rows and 3 columns

---

LDS\_C07\_HEMOGLOB      *Large Data HEMOglob from Chapter 7*

---

**Description**

LDS\_C07\_HEMOGLOB

**Usage**

LDS\_C07\_HEMOGLOB

**Format**

A [data.frame](#) with 1000 rows and 2 columns

---

LDS\_C07\_MANDEXT      *Large Data MANDEXT from Chapter 7*

---

**Description**

LDS\_C07\_MANDEXT

**Usage**

LDS\_C07\_MANDEXT

**Format**

A [data.frame](#) with 1000 rows and 2 columns



---

LDS_C07_PCKDATA	<i>Large Data PCKDATA from Chapter 7</i>
-----------------	--

---

**Description**

LDS\_C07\_PCKDATA

**Usage**

LDS\_C07\_PCKDATA

**Format**A [data.frame](#) with 1005 rows and 3 columns

---

LDS_C07_PROTHROM	<i>Large Data PROTHROM from Chapter 7</i>
------------------	---

---

**Description**

LDS\_C07\_PROTHROM

**Usage**

LDS\_C07\_PROTHROM

**Format**A [data.frame](#) with 1000 rows and 2 columns

---

LDS_C08_CSFDATA	<i>Large Data CSFDATA from Chapter 8</i>
-----------------	--

---

**Description**

LDS\_C08\_CSFDATA

**Usage**

LDS\_C08\_CSFDATA

**Format**A [data.frame](#) with 300 rows and 6 columns

---

LDS\_C08\_LSADATA      *Large Data LSADATA from Chapter 8*

---

**Description**

LDS\_C08\_LSADATA

**Usage**

LDS\_C08\_LSADATA

**Format**

A [data.frame](#) with 350 rows and 5 columns

---

LDS\_C08\_MEDSCORES      *Large Data MEDSCORES from Chapter 8*

---

**Description**

LDS\_C08\_MEDSCORES

**Usage**

LDS\_C08\_MEDSCORES

**Format**

A [data.frame](#) with 582 rows and 4 columns

---

LDS\_C08\_RBCDATA      *Large Data RBCDATA from Chapter 8*

---

**Description**

LDS\_C08\_RBCDATA

**Usage**

LDS\_C08\_RBCDATA

**Format**

A [data.frame](#) with 350 rows and 4 columns

---

LDS\_C08\_SACEDATA      *Large Data SACEDATA from Chapter 8*

---

**Description**

LDS\_C08\_SACEDATA

**Usage**

LDS\_C08\_SACEDATA

**Format**

A [data.frame](#) with 400 rows and 5 columns

---

LDS\_C08\_SERUMCHO      *Large Data SERUMCHO from Chapter 8*

---

**Description**

LDS\_C08\_SERUMCHO

**Usage**

LDS\_C08\_SERUMCHO

**Format**

A [data.frame](#) with 347 rows and 4 columns

---

LDS\_C09\_CALCIIUM      *Large Data CALCIIUM from Chapter 9*

---

**Description**

LDS\_C09\_CALCIIUM

**Usage**

LDS\_C09\_CALCIIUM

**Format**

A [data.frame](#) with 100 rows and 13 columns

---

LDS\_C09\_CEREBRAL      *Large Data CEREBRAL from Chapter 9*

---

**Description**

LDS\_C09\_CEREBRAL

**Usage**

LDS\_C09\_CEREBRAL

**Format**

A [data.frame](#) with 1050 rows and 3 columns

---

LDS\_C09\_HYPERTEN      *Large Data HYPERTEN from Chapter 9*

---

**Description**

LDS\_C09\_HYPERTEN

**Usage**

LDS\_C09\_HYPERTEN

**Format**

A [data.frame](#) with 1050 rows and 3 columns

---

LDS\_C10\_LTEXER      *Large Data LTEXER from Chapter 10*

---

**Description**

LDS\_C10\_LTEXER

**Usage**

LDS\_C10\_LTEXER

**Format**

A [data.frame](#) with 248 rows and 5 columns

---

LDS_C10_RESPDIS	<i>Large Data RESPDIS from Chapter 10</i>
-----------------	---

---

**Description**

LDS\_C10\_RESPDIS

**Usage**

LDS\_C10\_RESPDIS

**Format**A [data.frame](#) with 1200 rows and 6 columns

---

LDS_C10_RISKFACT	<i>Large Data RISKFACT from Chapter 10</i>
------------------	--

---

**Description**

LDS\_C10\_RISKFACT

**Usage**

LDS\_C10\_RISKFACT

**Format**A [data.frame](#) with 1000 rows and 6 columns

---

LDS_C10_STERLENGTH	<i>Large Data STERLENGTH from Chapter 10</i>
--------------------	--

---

**Description**

LDS\_C10\_STERLENGTH

**Usage**

LDS\_C10\_STERLENGTH

**Format**A [data.frame](#) with 1162 rows and 4 columns

---

LDS\_C11\_AQUATICS      *Large Data AQUATICS from Chapter 11*

---

**Description**

LDS\_C11\_AQUATICS

**Usage**

LDS\_C11\_AQUATICS

**Format**

A [data.frame](#) with 142 rows and 7 columns

---

LDS\_C11\_TEACHERS      *Large Data TEACHERS from Chapter 11*

---

**Description**

LDS\_C11\_TEACHERS

**Usage**

LDS\_C11\_TEACHERS

**Format**

A [data.frame](#) with 212 rows and 7 columns

---

LDS\_C11\_WGTLOSS      *Large Data WGTLOSS from Chapter 11*

---

**Description**

LDS\_C11\_WGTLOSS

**Usage**

LDS\_C11\_WGTLOSS

**Format**

A [data.frame](#) with 1185 rows and 3 columns

---

LDS_C12_SMOKING	<i>Large Data SMOKING from Chapter 12</i>
-----------------	---

---

**Description**

LDS\_C12\_SMOKING

**Usage**

LDS\_C12\_SMOKING

**Format**A [data.frame](#) with 1200 rows and 6 columns

---

LDS_C13_KLETTER	<i>Large Data KLETTER from Chapter 13</i>
-----------------	---

---

**Description**

LDS\_C13\_KLETTER

**Usage**

LDS\_C13\_KLETTER

**Format**A [data.frame](#) with 168 rows and 3 columns

---

power-class	<i>S4 class power</i>
-------------	-----------------------

---

**Description**S4 class [power](#)**Slots**.Data [numeric](#) scalar or vector, power(s) calculated at alternative parameter(s)  $\mu_1$ x [numeric](#) scalar or vector, alternative parameter(s)  $\mu_1$ rr [RejectionRegion](#) object

---

RejectionRegion-class *S4 class [RejectionRegion](#)*

---

### Description

S4 class [RejectionRegion](#)

### Slots

.Data [numeric](#) scalar for one-sided test, or length-two [numeric](#) vector for two-sided test  
 null.value [numeric](#) scalar, null value  
 std.err [numeric](#) scalar, standard error of sampling distribution  
 parameter [numeric](#) vector, additional parameters  
 alternative [character](#) scalar, alternative hypothesis  
 sig.level [numeric](#) scalar, significance level (Type I error probability)  
 test [character](#) scalar, type of test. Currently only 'z' is supported

---

REV\_C02\_13

*Review Exercise 13 of Chapter 2*

---

### Description

REV\_C02\_13

### Usage

REV\_C02\_13

### Format

A [data.frame](#) with 50 rows and 1 columns

---

REV\_C02\_15

*Review Exercise 15 of Chapter 2*

---

### Description

REV\_C02\_15

### Usage

REV\_C02\_15

### Format

A [data.frame](#) with 28 rows and 1 columns



---

REV\_C02\_16                      *Review Exercise 16 of Chapter 2*

---

**Description**

REV\_C02\_16

**Usage**

REV\_C02\_16

**Format**

A [data.frame](#) with 53 rows and 2 columns

---

REV\_C02\_19                      *Review Exercise 19 of Chapter 2*

---

**Description**

REV\_C02\_19

**Usage**

REV\_C02\_19

**Format**

A [data.frame](#) with 22 rows and 1 columns

---

REV\_C02\_29                      *Review Exercise 29 of Chapter 2*

---

**Description**

REV\_C02\_29

**Usage**

REV\_C02\_29

**Format**

A [data.frame](#) with 107 rows and 1 columns

---

REV\_C06\_22

*Review Exercise 22 of Chapter 6*

---

**Description**

REV\_C06\_22

**Usage**

REV\_C06\_22

**Format**

A [data.frame](#) with 27 rows and 2 columns

---

REV\_C06\_23

*Review Exercise 23 of Chapter 6*

---

**Description**

REV\_C06\_23

**Usage**

REV\_C06\_23

**Format**

A [data.frame](#) with 28 rows and 2 columns

---

REV\_C06\_28

*Review Exercise 28 of Chapter 6*

---

**Description**

REV\_C06\_28

**Usage**

REV\_C06\_28

**Format**

A [data.frame](#) with 110 rows and 2 columns

---

REV\_C07\_18                      *Review Exercise 18 of Chapter 7*

---

**Description**

REV\_C07\_18

**Usage**

REV\_C07\_18

**Format**

A [data.frame](#) with 107 rows and 3 columns

---

REV\_C07\_19                      *Review Exercise 19 of Chapter 7*

---

**Description**

REV\_C07\_19

**Usage**

REV\_C07\_19

**Format**

A [data.frame](#) with 107 rows and 3 columns

---

REV\_C07\_22                      *Review Exercise 22 of Chapter 7*

---

**Description**

REV\_C07\_22

**Usage**

REV\_C07\_22

**Format**

A [data.frame](#) with 76 rows and 2 columns

---

REV\_C07\_24                      *Review Exercise 24 of Chapter 7*

---

**Description**

REV\_C07\_24

**Usage**

REV\_C07\_24

**Format**

A [data.frame](#) with 37 rows and 2 columns

---

REV\_C07\_29                      *Review Exercise 29 of Chapter 7*

---

**Description**

REV\_C07\_29

**Usage**

REV\_C07\_29

**Format**

A [data.frame](#) with 12 rows and 2 columns

---

REV\_C07\_40                      *Review Exercise 40 of Chapter 7*

---

**Description**

REV\_C07\_40

**Usage**

REV\_C07\_40

**Format**

A [data.frame](#) with 8 rows and 3 columns

---

REV\_C07\_41                      *Review Exercise 41 of Chapter 7*

---

**Description**

REV\_C07\_41

**Usage**

REV\_C07\_41

**Format**

A [data.frame](#) with 11 rows and 3 columns

---

REV\_C07\_42                      *Review Exercise 42 of Chapter 7*

---

**Description**

REV\_C07\_42

**Usage**

REV\_C07\_42

**Format**

A [data.frame](#) with 10 rows and 6 columns

---

REV\_C07\_43                      *Review Exercise 43 of Chapter 7*

---

**Description**

REV\_C07\_43

**Usage**

REV\_C07\_43

**Format**

A [data.frame](#) with 31 rows and 2 columns

---

REV\_C07\_44

*Review Exercise 44 of Chapter 7*

---

**Description**

REV\_C07\_44

**Usage**

REV\_C07\_44

**Format**

A [data.frame](#) with 98 rows and 4 columns

---

REV\_C07\_45

*Review Exercise 45 of Chapter 7*

---

**Description**

REV\_C07\_45

**Usage**

REV\_C07\_45

**Format**

A [data.frame](#) with 15 rows and 11 columns

---

REV\_C07\_46

*Review Exercise 46 of Chapter 7*

---

**Description**

REV\_C07\_46

**Usage**

REV\_C07\_46

**Format**

A [data.frame](#) with 17 rows and 2 columns

---

REV\_C07\_47

*Review Exercise 47 of Chapter 7*

---

**Description**

REV\_C07\_47

**Usage**

REV\_C07\_47

**Format**

A [data.frame](#) with 66 rows and 2 columns

---

REV\_C07\_48

*Review Exercise 48 of Chapter 7*

---

**Description**

REV\_C07\_48

**Usage**

REV\_C07\_48

**Format**

A [data.frame](#) with 51 rows and 2 columns

---

REV\_C07\_49

*Review Exercise 49 of Chapter 7*

---

**Description**

REV\_C07\_49

**Usage**

REV\_C07\_49

**Format**

A [data.frame](#) with 22 rows and 2 columns

---

REV\_C07\_50

*Review Exercise 50 of Chapter 7*

---

**Description**

REV\_C07\_50

**Usage**

REV\_C07\_50

**Format**

A [data.frame](#) with 28 rows and 4 columns

---

REV\_C07\_51

*Review Exercise 51 of Chapter 7*

---

**Description**

REV\_C07\_51

**Usage**

REV\_C07\_51

**Format**

A [data.frame](#) with 22 rows and 2 columns

---

REV\_C07\_52

*Review Exercise 52 of Chapter 7*

---

**Description**

REV\_C07\_52

**Usage**

REV\_C07\_52

**Format**

A [data.frame](#) with 24 rows and 2 columns



---

REV\_C07\_53

*Review Exercise 53 of Chapter 7*

---

**Description**

REV\_C07\_53

**Usage**

REV\_C07\_53

**Format**

A [data.frame](#) with 55 rows and 2 columns

---

REV\_C07\_54

*Review Exercise 54 of Chapter 7*

---

**Description**

REV\_C07\_54

**Usage**

REV\_C07\_54

**Format**

A [data.frame](#) with 17 rows and 2 columns

---

REV\_C07\_55

*Review Exercise 55 of Chapter 7*

---

**Description**

REV\_C07\_55

**Usage**

REV\_C07\_55

**Format**

A [data.frame](#) with 50 rows and 2 columns

---

REV\_C08\_13                      *Review Exercise 13 of Chapter 8*

---

**Description**

REV\_C08\_13

**Usage**

REV\_C08\_13

**Format**

A [data.frame](#) with 75 rows and 2 columns

---

REV\_C08\_14                      *Review Exercise 14 of Chapter 8*

---

**Description**

REV\_C08\_14

**Usage**

REV\_C08\_14

**Format**

A [data.frame](#) with 91 rows and 2 columns

---

REV\_C08\_15                      *Review Exercise 15 of Chapter 8*

---

**Description**

REV\_C08\_15

**Usage**

REV\_C08\_15

**Format**

A [data.frame](#) with 48 rows and 3 columns

---

REV\_C08\_16                      *Review Exercise 16 of Chapter 8*

---

**Description**

REV\_C08\_16

**Usage**

REV\_C08\_16

**Format**

A [data.frame](#) with 36 rows and 3 columns

---

REV\_C08\_17                      *Review Exercise 17 of Chapter 8*

---

**Description**

REV\_C08\_17

**Usage**

REV\_C08\_17

**Format**

A [data.frame](#) with 52 rows and 3 columns

---

REV\_C08\_18                      *Review Exercise 18 of Chapter 8*

---

**Description**

REV\_C08\_18

**Usage**

REV\_C08\_18

**Format**

A [data.frame](#) with 74 rows and 4 columns

---

REV\_C08\_19

*Review Exercise 19 of Chapter 8*

---

**Description**

REV\_C08\_19

**Usage**

REV\_C08\_19

**Format**

A [data.frame](#) with 162 rows and 3 columns

---

REV\_C08\_20

*Review Exercise 20 of Chapter 8*

---

**Description**

REV\_C08\_20

**Usage**

REV\_C08\_20

**Format**

A [data.frame](#) with 56 rows and 2 columns

---

REV\_C08\_21

*Review Exercise 21 of Chapter 8*

---

**Description**

REV\_C08\_21

**Usage**

REV\_C08\_21

**Format**

A [data.frame](#) with 30 rows and 3 columns

---

REV\_C08\_22

*Review Exercise 22 of Chapter 8*

---

**Description**

REV\_C08\_22

**Usage**

REV\_C08\_22

**Format**

A [data.frame](#) with 54 rows and 3 columns

---

REV\_C08\_23

*Review Exercise 23 of Chapter 8*

---

**Description**

REV\_C08\_23

**Usage**

REV\_C08\_23

**Format**

A [data.frame](#) with 31 rows and 2 columns

---

REV\_C08\_24

*Review Exercise 24 of Chapter 8*

---

**Description**

REV\_C08\_24

**Usage**

REV\_C08\_24

**Format**

A [data.frame](#) with 30 rows and 3 columns

---

REV\_C08\_25                      *Review Exercise 25 of Chapter 8*

---

**Description**

REV\_C08\_25

**Usage**

REV\_C08\_25

**Format**

A [data.frame](#) with 60 rows and 3 columns

---

REV\_C08\_31                      *Review Exercise 31 of Chapter 8*

---

**Description**

REV\_C08\_31

**Usage**

REV\_C08\_31

**Format**

A [data.frame](#) with 28 rows and 1 columns

---

REV\_C08\_32                      *Review Exercise 32 of Chapter 8*

---

**Description**

REV\_C08\_32

**Usage**

REV\_C08\_32

**Format**

A [data.frame](#) with 48 rows and 1 columns

---

REV\_C08\_33

*Review Exercise 33 of Chapter 8*

---

**Description**

REV\_C08\_33

**Usage**

REV\_C08\_33

**Format**

A [data.frame](#) with 25 rows and 2 columns

---

REV\_C08\_39

*Review Exercise 39 of Chapter 8*

---

**Description**

REV\_C08\_39

**Usage**

REV\_C08\_39

**Format**

A [data.frame](#) with 18 rows and 10 columns

---

REV\_C08\_40

*Review Exercise 40 of Chapter 8*

---

**Description**

REV\_C08\_40

**Usage**

REV\_C08\_40

**Format**

A [data.frame](#) with 30 rows and 3 columns

---

REV\_C08\_41

*Review Exercise 41 of Chapter 8*

---

**Description**

REV\_C08\_41

**Usage**

REV\_C08\_41

**Format**

A [data.frame](#) with 24 rows and 2 columns

---

REV\_C08\_42

*Review Exercise 42 of Chapter 8*

---

**Description**

REV\_C08\_42

**Usage**

REV\_C08\_42

**Format**

A [data.frame](#) with 14 rows and 8 columns

---

REV\_C08\_43

*Review Exercise 43 of Chapter 8*

---

**Description**

REV\_C08\_43

**Usage**

REV\_C08\_43

**Format**

A [data.frame](#) with 24 rows and 5 columns



---

REV\_C08\_44                      *Review Exercise 44 of Chapter 8*

---

**Description**

REV\_C08\_44

**Usage**

REV\_C08\_44

**Format**

A [data.frame](#) with 16 rows and 14 columns

---

REV\_C08\_45                      *Review Exercise 45 of Chapter 8*

---

**Description**

REV\_C08\_45

**Usage**

REV\_C08\_45

**Format**

A [data.frame](#) with 90 rows and 2 columns

---

REV\_C08\_46                      *Review Exercise 46 of Chapter 8*

---

**Description**

REV\_C08\_46

**Usage**

REV\_C08\_46

**Format**

A [data.frame](#) with 20 rows and 5 columns

---

REV\_C08\_47

*Review Exercise 47 of Chapter 8*

---

**Description**

REV\_C08\_47

**Usage**

REV\_C08\_47

**Format**

A [data.frame](#) with 18 rows and 3 columns

---

REV\_C08\_48

*Review Exercise 48 of Chapter 8*

---

**Description**

REV\_C08\_48

**Usage**

REV\_C08\_48

**Format**

A [data.frame](#) with 34 rows and 2 columns

---

REV\_C08\_49

*Review Exercise 49 of Chapter 8*

---

**Description**

REV\_C08\_49

**Usage**

REV\_C08\_49

**Format**

A [data.frame](#) with 24 rows and 3 columns

---

REV\_C08\_50                      *Review Exercise 50 of Chapter 8*

---

**Description**

REV\_C08\_50

**Usage**

REV\_C08\_50

**Format**

A [data.frame](#) with 20 rows and 5 columns

---

REV\_C08\_51                      *Review Exercise 51 of Chapter 8*

---

**Description**

REV\_C08\_51

**Usage**

REV\_C08\_51

**Format**

A [data.frame](#) with 36 rows and 3 columns

---

REV\_C08\_52                      *Review Exercise 52 of Chapter 8*

---

**Description**

REV\_C08\_52

**Usage**

REV\_C08\_52

**Format**

A [data.frame](#) with 65 rows and 2 columns

---

REV\_C08\_53

*Review Exercise 53 of Chapter 8*

---

**Description**

REV\_C08\_53

**Usage**

REV\_C08\_53

**Format**

A [data.frame](#) with 11 rows and 2 columns

---

REV\_C08\_54

*Review Exercise 54 of Chapter 8*

---

**Description**

REV\_C08\_54

**Usage**

REV\_C08\_54

**Format**

A [data.frame](#) with 22 rows and 8 columns

---

REV\_C08\_55

*Review Exercise 55 of Chapter 8*

---

**Description**

REV\_C08\_55

**Usage**

REV\_C08\_55

**Format**

A [data.frame](#) with 41 rows and 2 columns

---

REV\_C08\_56

*Review Exercise 56 of Chapter 8*

---

**Description**

REV\_C08\_56

**Usage**

REV\_C08\_56

**Format**

A [data.frame](#) with 14 rows and 8 columns

---

REV\_C08\_57

*Review Exercise 57 of Chapter 8*

---

**Description**

REV\_C08\_57

**Usage**

REV\_C08\_57

**Format**

A [data.frame](#) with 119 rows and 2 columns

---

REV\_C08\_58

*Review Exercise 58 of Chapter 8*

---

**Description**

REV\_C08\_58

**Usage**

REV\_C08\_58

**Format**

A [data.frame](#) with 173 rows and 2 columns

---

REV\_C08\_59                      *Review Exercise 59 of Chapter 8*

---

**Description**

REV\_C08\_59

**Usage**

REV\_C08\_59

**Format**

A [data.frame](#) with 192 rows and 2 columns

---

REV\_C08\_60                      *Review Exercise 60 of Chapter 8*

---

**Description**

REV\_C08\_60

**Usage**

REV\_C08\_60

**Format**

A [data.frame](#) with 24 rows and 2 columns

---

REV\_C08\_61                      *Review Exercise 61 of Chapter 8*

---

**Description**

REV\_C08\_61

**Usage**

REV\_C08\_61

**Format**

A [data.frame](#) with 32 rows and 2 columns

---

REV\_C08\_62

*Review Exercise 62 of Chapter 8*

---

**Description**

REV\_C08\_62

**Usage**

REV\_C08\_62

**Format**

A [data.frame](#) with 14 rows and 12 columns

---

REV\_C08\_63

*Review Exercise 63 of Chapter 8*

---

**Description**

REV\_C08\_63

**Usage**

REV\_C08\_63

**Format**

A [data.frame](#) with 30 rows and 2 columns

---

REV\_C08\_64

*Review Exercise 64 of Chapter 8*

---

**Description**

REV\_C08\_64

**Usage**

REV\_C08\_64

**Format**

A [data.frame](#) with 60 rows and 2 columns

---

REV\_C08\_65

*Review Exercise 65 of Chapter 8*

---

**Description**

REV\_C08\_65

**Usage**

REV\_C08\_65

**Format**

A [data.frame](#) with 20 rows and 2 columns

---

REV\_C08\_66

*Review Exercise 66 of Chapter 8*

---

**Description**

REV\_C08\_66

**Usage**

REV\_C08\_66

**Format**

A [data.frame](#) with 15 rows and 2 columns

---

REV\_C09\_16

*Review Exercise 16 of Chapter 9*

---

**Description**

REV\_C09\_16

**Usage**

REV\_C09\_16

**Format**

A [data.frame](#) with 29 rows and 2 columns



---

REV\_C09\_17                      *Review Exercise 17 of Chapter 9*

---

**Description**

REV\_C09\_17

**Usage**

REV\_C09\_17

**Format**

A [data.frame](#) with 89 rows and 2 columns

---

REV\_C09\_18                      *Review Exercise 18 of Chapter 9*

---

**Description**

REV\_C09\_18

**Usage**

REV\_C09\_18

**Format**

A [data.frame](#) with 31 rows and 5 columns

---

REV\_C09\_19                      *Review Exercise 19 of Chapter 9*

---

**Description**

REV\_C09\_19

**Usage**

REV\_C09\_19

**Format**

A [data.frame](#) with 19 rows and 2 columns

---

REV\_C09\_20                      *Review Exercise 20 of Chapter 9*

---

**Description**

REV\_C09\_20

**Usage**

REV\_C09\_20

**Format**

A [data.frame](#) with 16 rows and 2 columns

---

REV\_C09\_21                      *Review Exercise 21 of Chapter 9*

---

**Description**

REV\_C09\_21

**Usage**

REV\_C09\_21

**Format**

A [data.frame](#) with 15 rows and 2 columns

---

REV\_C09\_22                      *Review Exercise 22 of Chapter 9*

---

**Description**

REV\_C09\_22

**Usage**

REV\_C09\_22

**Format**

A [data.frame](#) with 12 rows and 2 columns

---

REV\_C09\_23

*Review Exercise 23 of Chapter 9*

---

**Description**

REV\_C09\_23

**Usage**

REV\_C09\_23

**Format**

A [data.frame](#) with 16 rows and 2 columns

---

REV\_C09\_24

*Review Exercise 24 of Chapter 9*

---

**Description**

REV\_C09\_24

**Usage**

REV\_C09\_24

**Format**

A [data.frame](#) with 20 rows and 2 columns

---

REV\_C09\_25

*Review Exercise 25 of Chapter 9*

---

**Description**

REV\_C09\_25

**Usage**

REV\_C09\_25

**Format**

A [data.frame](#) with 10 rows and 2 columns

---

REV\_C09\_29                      *Review Exercise 29 of Chapter 9*

---

**Description**

REV\_C09\_29

**Usage**

REV\_C09\_29

**Format**

A [data.frame](#) with 85 rows and 2 columns

---

REV\_C09\_30                      *Review Exercise 30 of Chapter 9*

---

**Description**

REV\_C09\_30

**Usage**

REV\_C09\_30

**Format**

A [data.frame](#) with 27 rows and 2 columns

---

REV\_C09\_31                      *Review Exercise 31 of Chapter 9*

---

**Description**

REV\_C09\_31

**Usage**

REV\_C09\_31

**Format**

A [data.frame](#) with 25 rows and 2 columns

---

REV\_C09\_32                      *Review Exercise 32 of Chapter 9*

---

**Description**

REV\_C09\_32

**Usage**

REV\_C09\_32

**Format**

A [data.frame](#) with 9 rows and 3 columns

---

REV\_C09\_33                      *Review Exercise 33 of Chapter 9*

---

**Description**

REV\_C09\_33

**Usage**

REV\_C09\_33

**Format**

A [data.frame](#) with 25 rows and 2 columns

---

REV\_C09\_34                      *Review Exercise 34 of Chapter 9*

---

**Description**

REV\_C09\_34

**Usage**

REV\_C09\_34

**Format**

A [data.frame](#) with 19 rows and 5 columns

---

REV\_C09\_35                      *Review Exercise 35 of Chapter 9*

---

**Description**

REV\_C09\_35

**Usage**

REV\_C09\_35

**Format**

A [data.frame](#) with 62 rows and 2 columns

---

REV\_C09\_36                      *Review Exercise 36 of Chapter 9*

---

**Description**

REV\_C09\_36

**Usage**

REV\_C09\_36

**Format**

A [data.frame](#) with 23 rows and 2 columns

---

REV\_C09\_37                      *Review Exercise 37 of Chapter 9*

---

**Description**

REV\_C09\_37

**Usage**

REV\_C09\_37

**Format**

A [data.frame](#) with 23 rows and 2 columns

---

REV\_C09\_38                      *Review Exercise 38 of Chapter 9*

---

**Description**

REV\_C09\_38

**Usage**

REV\_C09\_38

**Format**

A [data.frame](#) with 32 rows and 2 columns

---

REV\_C09\_39                      *Review Exercise 39 of Chapter 9*

---

**Description**

REV\_C09\_39

**Usage**

REV\_C09\_39

**Format**

A [data.frame](#) with 48 rows and 5 columns

---

REV\_C09\_40                      *Review Exercise 40 of Chapter 9*

---

**Description**

REV\_C09\_40

**Usage**

REV\_C09\_40

**Format**

A [data.frame](#) with 13 rows and 2 columns

---

REV\_C09\_41

*Review Exercise 41 of Chapter 9*

---

**Description**

REV\_C09\_41

**Usage**

REV\_C09\_41

**Format**

A [data.frame](#) with 66 rows and 2 columns

---

REV\_C09\_42

*Review Exercise 42 of Chapter 9*

---

**Description**

REV\_C09\_42

**Usage**

REV\_C09\_42

**Format**

A [data.frame](#) with 102 rows and 7 columns

---

REV\_C09\_43

*Review Exercise 43 of Chapter 9*

---

**Description**

REV\_C09\_43

**Usage**

REV\_C09\_43

**Format**

A [data.frame](#) with 14 rows and 4 columns



---

REV\_C09\_44                      *Review Exercise 44 of Chapter 9*

---

**Description**

REV\_C09\_44

**Usage**

REV\_C09\_44

**Format**

A [data.frame](#) with 44 rows and 2 columns

---

REV\_C09\_45                      *Review Exercise 45 of Chapter 9*

---

**Description**

REV\_C09\_45

**Usage**

REV\_C09\_45

**Format**

A [data.frame](#) with 172 rows and 2 columns

---

REV\_C09\_46                      *Review Exercise 46 of Chapter 9*

---

**Description**

REV\_C09\_46

**Usage**

REV\_C09\_46

**Format**

A [data.frame](#) with 33 rows and 4 columns

---

REV\_C10\_06

*Review Exercise 6 of Chapter 10*

---

**Description**

REV\_C10\_06

**Usage**

REV\_C10\_06

**Format**

A [data.frame](#) with 114 rows and 3 columns

---

REV\_C10\_07

*Review Exercise 7 of Chapter 10*

---

**Description**

REV\_C10\_07

**Usage**

REV\_C10\_07

**Format**

A [data.frame](#) with 15 rows and 3 columns

---

REV\_C10\_08

*Review Exercise 8 of Chapter 10*

---

**Description**

REV\_C10\_08

**Usage**

REV\_C10\_08

**Format**

A [data.frame](#) with 20 rows and 4 columns

---

REV\_C10\_09

*Review Exercise 9 of Chapter 10*

---

**Description**

REV\_C10\_09

**Usage**

REV\_C10\_09

**Format**

A [data.frame](#) with 15 rows and 3 columns

---

REV\_C10\_10

*Review Exercise 10 of Chapter 10*

---

**Description**

REV\_C10\_10

**Usage**

REV\_C10\_10

**Format**

A [data.frame](#) with 21 rows and 3 columns

---

REV\_C10\_11

*Review Exercise 11 of Chapter 10*

---

**Description**

REV\_C10\_11

**Usage**

REV\_C10\_11

**Format**

A [data.frame](#) with 15 rows and 5 columns

---

REV\_C10\_17                      *Review Exercise 17 of Chapter 10*

---

**Description**

REV\_C10\_17

**Usage**

REV\_C10\_17

**Format**

A [data.frame](#) with 26 rows and 13 columns

---

REV\_C10\_18                      *Review Exercise 18 of Chapter 10*

---

**Description**

REV\_C10\_18

**Usage**

REV\_C10\_18

**Format**

A [data.frame](#) with 34 rows and 7 columns

---

REV\_C10\_19                      *Review Exercise 19 of Chapter 10*

---

**Description**

REV\_C10\_19

**Usage**

REV\_C10\_19

**Format**

A [data.frame](#) with 96 rows and 8 columns

---

REV\_C11\_14                      *Review Exercise 14 of Chapter 11*

---

**Description**

REV\_C11\_14

**Usage**

REV\_C11\_14

**Format**

A [data.frame](#) with 70 rows and 5 columns

---

REV\_C11\_15                      *Review Exercise 15 of Chapter 11*

---

**Description**

REV\_C11\_15

**Usage**

REV\_C11\_15

**Format**

A [data.frame](#) with 28 rows and 3 columns

---

REV\_C11\_16                      *Review Exercise 16 of Chapter 11*

---

**Description**

REV\_C11\_16

**Usage**

REV\_C11\_16

**Format**

A [data.frame](#) with 27 rows and 3 columns

---

REV\_C11\_17                      *Review Exercise 17 of Chapter 11*

---

**Description**

REV\_C11\_17

**Usage**

REV\_C11\_17

**Format**

A [data.frame](#) with 40 rows and 3 columns

---

REV\_C11\_18                      *Review Exercise 18 of Chapter 11*

---

**Description**

REV\_C11\_18

**Usage**

REV\_C11\_18

**Format**

A [data.frame](#) with 31 rows and 4 columns

---

REV\_C11\_22                      *Review Exercise 22 of Chapter 11*

---

**Description**

REV\_C11\_22

**Usage**

REV\_C11\_22

**Format**

A [data.frame](#) with 12 rows and 3 columns

---

REV\_C11\_23

*Review Exercise 23 of Chapter 11*

---

**Description**

REV\_C11\_23

**Usage**

REV\_C11\_23

**Format**

A [data.frame](#) with 47 rows and 3 columns

---

REV\_C11\_24

*Review Exercise 24 of Chapter 11*

---

**Description**

REV\_C11\_24

**Usage**

REV\_C11\_24

**Format**

A [data.frame](#) with 129 rows and 3 columns

---

REV\_C11\_25

*Review Exercise 25 of Chapter 11*

---

**Description**

REV\_C11\_25

**Usage**

REV\_C11\_25

**Format**

A [data.frame](#) with 30 rows and 3 columns

---

REV\_C11\_26                      *Review Exercise 26 of Chapter 11*

---

**Description**

REV\_C11\_26

**Usage**

REV\_C11\_26

**Format**

A [data.frame](#) with 18 rows and 3 columns

---

REV\_C11\_27                      *Review Exercise 27 of Chapter 11*

---

**Description**

REV\_C11\_27

**Usage**

REV\_C11\_27

**Format**

A [data.frame](#) with 37 rows and 3 columns

---

REV\_C11\_28                      *Review Exercise 28 of Chapter 11*

---

**Description**

REV\_C11\_28

**Usage**

REV\_C11\_28

**Format**

A [data.frame](#) with 41 rows and 10 columns



---

REV\_C11\_29                      *Review Exercise 29 of Chapter 11*

---

**Description**

REV\_C11\_29

**Usage**

REV\_C11\_29

**Format**

A [data.frame](#) with 19 rows and 9 columns

---

REV\_C13\_06                      *Review Exercise 6 of Chapter 13*

---

**Description**

REV\_C13\_06

**Usage**

REV\_C13\_06

**Format**

A [data.frame](#) with 20 rows and 2 columns

---

REV\_C13\_08                      *Review Exercise 8 of Chapter 13*

---

**Description**

REV\_C13\_08

**Usage**

REV\_C13\_08

**Format**

A [data.frame](#) with 303 rows and 2 columns

---

REV\_C13\_09

*Review Exercise 9 of Chapter 13*

---

**Description**

REV\_C13\_09

**Usage**

REV\_C13\_09

**Format**

A [data.frame](#) with 10 rows and 4 columns

---

REV\_C13\_10

*Review Exercise 10 of Chapter 13*

---

**Description**

REV\_C13\_10

**Usage**

REV\_C13\_10

**Format**

A [data.frame](#) with 34 rows and 2 columns

---

REV\_C13\_13

*Review Exercise 13 of Chapter 13*

---

**Description**

REV\_C13\_13

**Usage**

REV\_C13\_13

**Format**

A [data.frame](#) with 70 rows and 2 columns

---

REV\_C13\_15                      *Review Exercise 15 of Chapter 13*

---

**Description**

REV\_C13\_15

**Usage**

REV\_C13\_15

**Format**

A [data.frame](#) with 12 rows and 2 columns

---

REV\_C13\_16                      *Review Exercise 16 of Chapter 13*

---

**Description**

REV\_C13\_16

**Usage**

REV\_C13\_16

**Format**

A [data.frame](#) with 43 rows and 5 columns

---

REV\_C13\_17                      *Review Exercise 17 of Chapter 13*

---

**Description**

REV\_C13\_17

**Usage**

REV\_C13\_17

**Format**

A [data.frame](#) with 67 rows and 2 columns

---

REV\_C13\_18                      *Review Exercise 18 of Chapter 13*

---

**Description**

REV\_C13\_18

**Usage**

REV\_C13\_18

**Format**

A [data.frame](#) with 18 rows and 3 columns

---

REV\_C13\_19                      *Review Exercise 19 of Chapter 13*

---

**Description**

REV\_C13\_19

**Usage**

REV\_C13\_19

**Format**

A [data.frame](#) with 50 rows and 2 columns

---

REV\_C13\_20                      *Review Exercise 20 of Chapter 13*

---

**Description**

REV\_C13\_20

**Usage**

REV\_C13\_20

**Format**

A [data.frame](#) with 31 rows and 3 columns

---

REV\_C13\_21                      *Review Exercise 21 of Chapter 13*

---

**Description**

REV\_C13\_21

**Usage**

REV\_C13\_21

**Format**

A [data.frame](#) with 45 rows and 3 columns

---

REV\_C13\_22                      *Review Exercise 22 of Chapter 13*

---

**Description**

REV\_C13\_22

**Usage**

REV\_C13\_22

**Format**

A [data.frame](#) with 18 rows and 2 columns

---

REV\_C13\_23                      *Review Exercise 23 of Chapter 13*

---

**Description**

REV\_C13\_23

**Usage**

REV\_C13\_23

**Format**

A [data.frame](#) with 44 rows and 5 columns

---

REV\_C13\_24

*Review Exercise 24 of Chapter 13*

---

**Description**

REV\_C13\_24

**Usage**

REV\_C13\_24

**Format**

A [data.frame](#) with 20 rows and 6 columns

---

REV\_C13\_25

*Review Exercise 25 of Chapter 13*

---

**Description**

REV\_C13\_25

**Usage**

REV\_C13\_25

**Format**

A [data.frame](#) with 20 rows and 3 columns

---

REV\_C13\_26

*Review Exercise 26 of Chapter 13*

---

**Description**

REV\_C13\_26

**Usage**

REV\_C13\_26

**Format**

A [data.frame](#) with 18 rows and 3 columns

---

REV\_C13\_27

*Review Exercise 27 of Chapter 13*

---

**Description**

REV\_C13\_27

**Usage**

REV\_C13\_27

**Format**

A [data.frame](#) with 9 rows and 6 columns

---

REV\_C13\_28

*Review Exercise 28 of Chapter 13*

---

**Description**

REV\_C13\_28

**Usage**

REV\_C13\_28

**Format**

A [data.frame](#) with 31 rows and 2 columns

---

REV\_C13\_29

*Review Exercise 29 of Chapter 13*

---

**Description**

REV\_C13\_29

**Usage**

REV\_C13\_29

**Format**

A [data.frame](#) with 17 rows and 2 columns

REV\_C14\_11

*Review Exercise 11 of Chapter 14*

---

**Description**

REV\_C14\_11

**Usage**

REV\_C14\_11

**Format**A [data.frame](#) with 55 rows and 4 columns

---

REV\_C14\_12

*Review Exercise 12 of Chapter 14*

---

**Description**

REV\_C14\_12

**Usage**

REV\_C14\_12

**Format**A [data.frame](#) with 77 rows and 4 columns

---

show,BooleanRisk-method

*Show [BooleanRisk](#) Object*

---

**Description**Show [BooleanRisk](#) object**Usage**

```
## S4 method for signature 'BooleanRisk'  
show(object)
```



**Arguments**

object            a [BooleanRisk](#) object

**Value**

The [show](#) method for [BooleanRisk](#) object does not have a returned value.

---

show, BooleanTest-method

*Show [BooleanTest](#) Object*

---

**Description**

Show [BooleanTest](#) object

**Usage**

```
## S4 method for signature 'BooleanTest'  
show(object)
```

**Arguments**

object            a [BooleanTest](#) object

**Value**

The [show](#) method for [BooleanTest](#) object does not have a returned value.

---

show, freqs-method

*Show [freqs](#) Object*

---

**Description**

Show [freqs](#) object

**Usage**

```
## S4 method for signature 'freqs'  
show(object)
```

**Arguments**

object            an [freqs](#) object

**Value**

The [show](#) method for [freqs](#) object does not have a returned value.

---

show,power-method	<i>Show <a href="#">power</a> Object</i>
-------------------	--

---

**Description**

Show [power](#) object

**Usage**

```
## S4 method for signature 'power'  
show(object)
```

**Arguments**

object            a [power](#) object

**Value**

The [show](#) method for [power](#) object does not have a returned value.

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