

# Package ‘moments’

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**Type** Package

**Title** Moments, Cumulants, Skewness, Kurtosis and Related Tests

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**Author** Lukasz Komsta <lukasz.komsta@umlub.pl>, Frederick Novomestky  
<fnovomes@poly.edu>

**Maintainer** Lukasz Komsta <lukasz.komsta@umlub.pl>

**Description** Functions to calculate: moments, Pearson's kurtosis,  
Geary's kurtosis and skewness; tests related to them  
(Anscombe-Glynn, D'Agostino, Bonett-Seier).

**License** GPL (>= 2)

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agostino.test	<i>D'Agostino test of skewness</i>
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### Description

Performs D'Agostino test for skewness in normally distributed data.

### Usage

```
agostino.test(x, alternative = c("two.sided", "less", "greater"))
```

### Arguments

x	a numeric vector of data values.
alternative	a character string specifying the alternative hypothesis, must be one of "two.sided" (default), "greater" or "less". You can specify just the initial letter.

### Details

Under the hypothesis of normality, data should be symmetrical (i.e. skewness should be equal to zero). This test has such null hypothesis and is useful to detect a significant skewness in normally distributed data.

### Value

A list with class `htest` containing the following components:

statistic	the list containing skewness estimator and its transformation.
p.value	the p-value for the test.
alternative	a character string describing the alternative hypothesis.
method	a character string indicating what type of test was performed.
data.name	name of the data argument.

### Author(s)

Lukasz Komsta

### References

D'Agostino, R.B. (1970). Transformation to Normality of the Null Distribution of  $G_1$ . *Biometrika*, 57, 3, 679-681.

### See Also

[skewness](#)

**Examples**

```
set.seed(1234)
x = rnorm(1000)
skewness(x)
agostino.test(x)
```

---

all.cumulants	<i>Statistical Cumulants</i>
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**Description**

This function calculates the cumulants for all orders specified in the given vector, matrix or data frame of raw moments

**Usage**

```
all.cumulants(mu.raw)
```

**Arguments**

mu.raw	A numeric vector, matrix or data frame of raw moments. For a vector, mu.raw[0] is the order 0 raw moment, mu.raw[1] is the order 1 raw moment and so forth. For a matrix or data frame, row vector mu.raw[0,] contains the order 0 raw moments, row vector mu.raw[1,] contains the order 1 raw moments and so forth.
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**Details**

No details are currently described.

**Value**

A vector matrix or data frame of cumulants. For matrices and data frame, column vectors correspond to different random variables.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Papoulis, A., Pillai, S. U. (2002) Probability, Random Variables and Stochastic Processes, Fourth Edition, McGraw-Hill, New York, 146-147.

**See Also**

[moment](#), [all.moments](#)

**Examples**

```

set.seed(1234)
x <- rnorm(10000)
mu.raw.x <- all.moments( x, order.max=6 )
all.cumulants( mu.raw.x )
M <- matrix( x, nrow=1000, ncol=10 )
mu.raw.M <- all.moments( M, order.max=6 )
all.cumulants( mu.raw.M )
D <- data.frame( M )
mu.raw.D <- all.moments( D, order.max=6 )
all.cumulants( mu.raw.D )

```

---

all.moments

*Statistical Moments*


---

**Description**

This function computes all the sample moments of the chosen type up to a given order.

**Usage**

```
all.moments(x, order.max = 2, central = FALSE, absolute = FALSE, na.rm = FALSE)
```

**Arguments**

x	A numeric vector, matrix or data frame of data. For matrices and data frames, each column is a random variable
order.max	the maximum order of the moments to be computed with a default value of 2.
central	a logical value, if TRUE, central moments are computed. Otherwise, raw moments are computed
absolute	a logical value, if TRUE, absolute moments are computed. Otherwise, standard moments are computed
na.rm	a logical value, if TRUE, remove NA values. Otherwise, keep NA values

**Details**

The minimum value for order.max is 2. The function stops running for values less than 2 and the message "maximum order should be at least 2" is displayed on standard output.

**Value**

A vector, matrix or data frame of moments depending on the nature of the argument x. If x is a vector, then the value returned is a vector, say mu, where mu[1] is the order 0 moment, mu[2] is the order 1 moment and so forth. If x is a matrix or data frame, then the value returned is a matrix or data frame, respectively. In this case, suppose mu is the value returned. Then, row vector mu[1,] contains the order 0 moments, mu[2,] contains the order 1 moments and so forth.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Papoulis, A., Pillai, S. U. (2002) Probability, Random Variables and Stochastic Processes, Fourth Edition, McGraw-Hill, New York, 146-147.

**See Also**

[moment](#), [raw2central](#)

**Examples**

```
set.seed(1234)
x <- rnorm(10000)
all.moments( x, order.max=4 )
all.moments( x, central=TRUE, order.max=4 )
all.moments( x, absolute=TRUE, order.max=4 )
all.moments( x, central=TRUE, absolute=TRUE, order.max=4 )
M <- matrix( x, nrow=1000, ncol=10 )
all.moments( M, order.max=4 )
all.moments( M, central=TRUE, order.max=4 )
all.moments( M, absolute=TRUE, order.max=4 )
all.moments( M, central=TRUE, absolute=TRUE, order.max=4 )
D <- data.frame( M )
all.moments( D, order.max=4 )
all.moments( D, central=TRUE, order.max=4 )
all.moments( D, absolute=TRUE, order.max=4 )
all.moments( D, central=TRUE, absolute=TRUE, order.max=4 )
```

---

anscombe.test

*Anscombe-Glynn test of kurtosis*

---

**Description**

Performs Anscombe-Glynn test of kurtosis for normal samples

**Usage**

```
anscombe.test(x, alternative = c("two.sided", "less", "greater"))
```

**Arguments**

x                    a numeric vector of data values.  
alternative        a character string specifying the alternative hypothesis, must be one of "two.sided" (default), "greater" or "less". You can specify just the initial letter.

**Details**

Under the hypothesis of normality, data should have kurtosis equal to 3. This test has such null hypothesis and is useful to detect a significant difference of kurtosis in normally distributed data.

**Value**

A list with class `htest` containing the following components:

<code>statistic</code>	the list containing kurtosis estimator and its transformation.
<code>p.value</code>	the p-value for the test.
<code>alternative</code>	a character string describing the alternative hypothesis.
<code>method</code>	a character string indicating what type of test was performed.
<code>data.name</code>	name of the data argument.

**Author(s)**

Lukasz Komsta

**References**

Anscombe, F.J., Glynn, W.J. (1983) Distribution of kurtosis statistic for normal statistics. *Biometrika*, 70, 1, 227-234

**See Also**

[kurtosis](#)

**Examples**

```
set.seed(1234)
x = rnorm(1000)
kurtosis(x)
anscombe.test(x)
```

---

`bonett.test`

*Bonett-Seier test of Geary's kurtosis*

---

**Description**

This function performs Bonett-Seier test of Geary's measure of kurtosis for normally distributed data.

**Usage**

```
bonett.test(x, alternative = c("two.sided", "less", "greater"))
```

**Arguments**

x	a numeric vector of data values.
alternative	a character string specifying the alternative hypothesis, must be one of "two.sided" (default), "greater" or "less". You can specify just the initial letter.

**Details**

Under the hypothesis of normality, data should have Geary's kurtosis equal to  $\sqrt{2/\pi}$  (0.7979). This test has such null hypothesis and is useful to detect a significant difference of Geary's kurtosis in normally distributed data.

**Value**

A list with class `htest` containing the following components:

statistic	the list containing Geary's kurtosis estimator and its transformation.
p.value	the p-value for the test.
alternative	a character string describing the alternative hypothesis.
method	a character string indicating what type of test was performed.
data.name	name of the data argument.

**Author(s)**

Lukasz Komsta

**References**

Bonett, D.G., Seier, E. (2002) A test of normality with high uniform power. *Computational Statistics and Data Analysis*, 40, 435-445.

**See Also**

[geary](#)

**Examples**

```
set.seed(1234)
x = rnorm(1000)
geary(x)
bonett.test(x)
```

---

central2raw                      *Central to raw moments*

---

### Description

This function transforms a vector, matrix or data frame of central moments to a vector, matrix or data frame of raw moments.

### Usage

```
central2raw(mu.central,eta)
```

### Arguments

mu.central	A numeric vector, matrix or data frame of central moments. For a vector, mu.central[0] is the order 0 central moment, mu.central[1] is the order 1 central moment and so forth. For a matrix or data frame, row vector mu.central[0,] contains the order 0 central moments, row vector mu.central[1,] contains the order 1 central moments and so forth.
eta	A numeric vector of sample mean or expected values

### Value

A vector matrix or data frame of raw moments. For matrices and data frame, column vectors correspond to different random variables.

### Author(s)

Frederick Novomestky <fnovomes@poly.edu>

### References

Papoulis, A., Pillai, S. U. (2002) Probability, Random Variables and Stochastic Processes, Fourth Edition, McGraw-Hill, New York, 146-147.

### See Also

[moment](#), [all.moments](#), [raw2central](#)

### Examples

```
set.seed(1234)
x <- rnorm(10000)
mu.raw.x <- all.moments( x, order.max=4 )
eta.x <- mu.raw.x[2]
mu.central.x <- all.moments( x, central=TRUE, order.max=4 )
central2raw( mu.central.x, eta.x )
mu.raw.x
```



```
M <- matrix( x, nrow=1000, ncol=10 )
mu.raw.M <- all.moments( M, order.max=4 )
eta.M <- mu.raw.M[2,]
mu.central.M <- all.moments( M, central=TRUE, order.max=4 )
central2raw( mu.central.M, eta.M )
mu.raw.M
D <- data.frame( M )
mu.raw.D <- all.moments( D, order.max=4 )
eta.D <- mu.raw.D[2,]
mu.central.D <- all.moments( D, central=TRUE, order.max=4 )
central2raw( mu.central.D, eta.D )
mu.raw.D
```

---

geary

*Geary's measure of kurtosis*

---

### Description

This function computes an estimator of Geary's measure of kurtosis.

### Usage

```
geary(x, na.rm = FALSE)
```

### Arguments

x	a numeric vector, matrix or data frame.
na.rm	logical. Should missing values be removed?

### Details

The Geary's kurtosis is computed by dividing average difference between observation and the mean by standard deviation of the sample.

### Author(s)

Lukasz Komsta

### References

Geary, R.C. (1936). Moments of the ratio of the mean deviation to the standard deviation for normal samples. *Biometrika*, 28, 295-307.

### See Also

[kurtosis](#), [bonett.test](#)

**Examples**

```
set.seed(1234)
geary(rnorm(1000))
```

---

jarque.test	<i>Jarque-Bera test for normality</i>
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---

**Description**

This function performs the Jarque-Bera test on the given data sample to determine if the data are sample drawn from a normal population.

**Usage**

```
jarque.test(x)
```

**Arguments**

x                    a numeric vector of data

**Details**

Under the hypothesis of normality, data should be symmetrical (i.e. skewness should be equal to zero) and have skewness close to three. The Jarque-Bera statistic is chi-square distributed with two degrees of freedom.

**Value**

A list with class `htest` containing the following components:

statistic	the list containing the Jarque-Bera statistic
p.value	the p-value for the test.
alternative	a character string describing the alternative hypothesis.
method	a character string indicating what type of test was performed.
data.name	name of the data argument.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

**References**

Jarque, C. M., Bera, A. K. (1980) Efficient test for normality, homoscedasticity and serial independence of residuals, *Economic Letters*, Vol. 6 Issue 3, 255-259.

**Examples**

```
set.seed( 1234 )  
x <- rnorm( 1000 )  
jarque.test( x )
```

---

kurtosis	<i>Pearson's measure of kurtosis</i>
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---

**Description**

This function computes the estimator of Pearson's measure of kurtosis.

**Usage**

```
kurtosis(x, na.rm = FALSE)
```

**Arguments**

x	a numeric vector, matrix or data frame.
na.rm	logical. Should missing values be removed?

**Author(s)**

Lukasz Komsta

**See Also**

[geary](#), [anscombe.test](#)

**Examples**

```
set.seed(1234)  
kurtosis(rnorm(1000))
```

---

moment	<i>Statistical Moments</i>
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**Description**

This function computes the sample moment of specified order.

**Usage**

```
moment(x, order = 1, central = FALSE, absolute = FALSE, na.rm = FALSE)
```

**Arguments**

x	a numeric vector of data.
order	order of the moment to be computed
central	a logical value - if central moments are to be computed.
absolute	a logical value - if absolute moments are to be computed.
na.rm	a logical value - remove NA values?

**Author(s)**

Lukasz Komsta

**Examples**

```
set.seed(1234)
x <- rnorm(10)
moment(x)
moment(x, order=3, absolute=TRUE)
```

---

raw2central

*Raw to central moments*

---

**Description**

This function transforms a vector, matrix or data frame of raw moments to a vector, matrix or data frame of central moments.

**Usage**

```
raw2central(mu.raw)
```

**Arguments**

mu.raw	A numeric vector, matrix or data frame of raw moments. For a vector, mu.raw[0] is the order 0 raw moment, mu.raw[1] is the order 1 raw moment and so forth. For a matrix or data frame, row vector mu.raw[0,] contains the order 0 raw moments, row vector mu.raw[1,] contains the order 1 raw moments and so forth.
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**Value**

A vector matrix or data frame of central moments. For matrices and data frame, column vectors correspond to different random variables.

**Author(s)**

Frederick Novomestky <fnovomes@poly.edu>

## References

Papoulis, A., Pillai, S. U. (2002) Probability, Random Variables and Stochastic Processes, Fourth Edition, McGraw-Hill, New York, 146-147.

## See Also

[moment](#), [all.moments](#), [central2raw](#)

## Examples

```
set.seed(1234)
x <- rnorm(10000)
mu.raw.x <- all.moments( x, order.max=4 )
mu.central.x <- all.moments( x, central=TRUE, order.max=4 )
raw2central( mu.raw.x )
mu.central.x
M <- matrix( x, nrow=1000, ncol=10 )
mu.raw.M <- all.moments( M, order.max=4 )
mu.central.M <- all.moments( M, central=TRUE, order.max=4 )
raw2central( mu.raw.M )
mu.central.M
D <- data.frame( M )
mu.raw.D <- all.moments( D, order.max=4 )
mu.central.D <- all.moments( D, central=TRUE, order.max=4 )
raw2central( mu.raw.D )
mu.central.D
```

---

skewness

*Skewness of the sample*

---

## Description

This function computes skewness of given data.

## Usage

```
skewness(x, na.rm = FALSE)
```

## Arguments

**x** a numeric vector, matrix or data frame.  
**na.rm** logical. Should missing values be removed?

## Author(s)

Lukasz Komsta

**See Also**[agostino.test](#)**Examples**

```
set.seed(1234)
skewness(rnorm(1000))
```

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