Package ‘Rita’

March 15, 2022

Type Package
Title Automated Transformations, Normality Testing, and Reporting
Version 1.2.0
Description Automated performance of common transformations used to fulfill parametric assumptions of normality and identification of the best performing method for the user. Output for various normality tests (Thode, 2002) corresponding to the best performing method and a descriptive statistical report of the input data in its original units (5-number summary and mathematical moments) are also presented. Lastly, the Rankit, an empirical normal quantile transformation (ENQT) (Soloman & Sawilowsky, 2009), is provided to accommodate non-standard use cases and facilitate adoption.

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Encoding UTF-8
Imports base, stats, lattice
RoxygenNote 7.1.2
NeedsCompilation no
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Repository CRAN
Date/Publication 2022-03-15 14:50:07 UTC

R topics documented:

ADTest
arcsineXform
chisqTest
DPTest
inverseXform
JBTest

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ADTest

Description

This function computes the one-sample Anderson-Darling test statistic and p-value for fit to a normal distribution.

Usage

\[
\text{ADTest}(\text{data, alpha = 0.05, } j = 1)
\]

Arguments

- **data**: Data of a univariate distribution for which the test statistic is computed (vector)
- **alpha**: The two-sided decision threshold used for hypothesis-testing
- **j**: The # hypotheses tested; used to compute a Bonferroni correction, if applicable; should remain at its default if multiple testing is not an issue (scalar)

Details

An adjusted statistic provided by D’agostino & Stephens (1986) is used, where the mean and variance of the population are treated as unknown. D’agostino & Stephen’s (1986) text provides the equations used to obtain the function’s p-values.

Value

An object including the test statistic, p-value, and a significance flag (list)

References

arcsineXform

Examples

```r
classes <- rnorm(100)
x <- ADTest(data = values)
```

---

<table>
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**Description**

This function transforms the scale, if needed, to values of unity. Then, the data is transformed by taking the arcsine of each value. Per the recommendations of Osborne (2002), data points are left-anchored at 0 to maximize the efficacy of the square-root transformation used enroute to the arcsine.

**Usage**

```r
arcsineXform(sample)
```

**Arguments**

- `sample`: The input data (vector)

**Value**

The arcsine-transformed data (vector)

**References**


**Examples**

```r
values <- rnorm(100)
x <- arcsineXform(values)
```
Description

This function computes the chi-square test for normality.

Usage

chisqTest(data, alpha = 0.05, j = 1, df = 3)

Arguments

data: Data of a univariate distribution for which the test statistic is computed (vector)
alpha: The two-sided decision threshold used for hypothesis-testing
j: The # hypotheses tested; used to compute a Bonferroni correction, if applicable; should remain at its default if multiple testing is not an issue (scalar)
df: The degrees of freedom used to test for significance against the sampling distribution (scalar)

Details

Bins are created by cutting the data to ensure that values within these intervals would be equally probable if data are normal (Moore, 1986). By default, this function assumes that all relevant parameters (mu, sigma) are estimators, fixing the degrees of freedom at df = 3.

Value

An object including the test statistic, p-value, and a significance flag (list)

References


Examples

values <- rnorm(100)
x <- chisqTest(data = values)
**DPTest**

**D'agostino Pearson Omnibus Test**

**Description**

This function computes the D’agostino Pearson omnibus test using adjusted Fisher-Pearson skewness and kurtosis estimators.

**Usage**

DPTest(data, alpha = 0.05, j = 1, warn = T)

**Arguments**

- **data**: Data of a univariate distribution for which the test statistic is computed (vector)
- **alpha**: The two-sided decision threshold used for hypothesis-testing
- **j**: The # hypotheses tested; used to compute a Bonferroni correction, if applicable; should remain at its default if multiple testing is not an issue (scalar)
- **warn**: Used for printing a warning message when testing is terminated for N < 8 (boolean)

**Value**

An object including the test statistic, p-value, and a significance flag (list)

**References**


**Examples**

values <- rnorm(100)
x <- DPTest(data = values)
inverseXform  Inverse/Reciprocal Transformation

Description
This function imputes minimum values per the recommendations of Osborne (2002) and subsequently transforms the data using the reciprocal.

Usage
inverseXform(sample)

Arguments

sample  The input data (vector)

Value
The reciprocal-transformed data (vector)

References

Examples

values <- rnorm(100)
x <- inverseXform(values)

JBTest  Jarque-Bera Test

Description
This function performs the Jarque-Bera test for normality using adjusted Fisher-Pearson skewness and kurtosis coefficients.

Usage

JBTest(data, alpha = 0.05, j = 1, N_Sample = 10000, warn = T)
**KSLTest**

**Description**

This function computes the Lilliefors variant of the one-sample Kolmogorov-Smirnov test.

**Usage**

```r
KSLTest(data, alpha = 0.05, j = 1, warn = T)
```
Arguments

data The data of a univariate distribution for which the test statistic is computed (vector)
alpha The two-sided decision threshold used for hypothesis-testing (scalar)
j The # hypotheses tested; used to compute a Bonferonni correction, if applicable; should remain at its default if multiple testing is not an issue (scalar)
warn Used for printing a warning message when negative values are imputed to 0.0 (boolean)

Details

Molin & Abdi’s (1998) algorithmic approximation of p-values is used for hypothesis-testing. Note that this algorithm requires the imputation of 0.0 for negative output when p-values would otherwise be low in value (< 0.001) using other methods. A similar issue with extremely large values requires the imputation of 1.0 for values larger than 1.0 when p > .99.

Value

An object including the test statistic, p-value, and a significance flag (list)

References


Examples

values <- rnorm(100)
x <- KSLTest(data = values)

---

kurtCoeff Adjusted Fisher-Pearson Excess Sample Kurtosis

Description

Adjusted Fisher-Pearson Excess Sample Kurtosis

Usage

kurtCoeff(data, sd)

Arguments

data The data for which kurtosis is computed (vector)
sd The population standard deviation, used to compute kurtosis (scalar)
logitXform

Value

The kurtosis value (scalar)

References


Examples

values <- rnorm(100)
x <- kurtCoeff(data = values, sd = sd(values))

logitXform

Logit/Log-Odds Transformation

Description

This function transforms data via the logit/log-odds transformation.

Usage

logitXform(sample, divisor = 2)

Arguments

sample The input data (vector, matrix, or dataframe)
divisor Number used to modify epsilon enroute to the empirical logit, in cases of output consisting of a single distinct value (scalar)

Details

 Initially, features of the input data are extracted and used to determine an initial transformation to perform. All forms of data representing an underlying discrete scale are converted to proportions of the total sample size, if needed. In these cases, values should be stored such that elements are in absolute frequency, relative frequency, or percentage form.

For non-count data, variables are shifted and bounded at [0,1] in a manner analogous to the potential transformations of the scale performed by arcsineXform() prior to the arcine, although transformed values are not expected to outperform more suitable transformations.

Then, the empirical logit transformation is applied to avoid zeroes or ones, and the data are transformed by taking the log-odds/logit of each value.

Value

The logit-transformed data (vector)
logXform

References


Examples

values <- rnorm(100)
x <- logXform(values)

logXform

Logarithmic Transformation

Description

This function imputes minimum values per the recommendations of Osborne (2002) and subsequently transforms the data to a base-10 logarithmic scale.

Usage

logXform(sample)

Arguments

sample The input data (vector)

Value

The log-transformed data (vector)

References


Examples

values <- rnorm(100)
x <- logXform(values)
MasterTest

**Master Normality Testing Function**

**Description**
This is a master function to call the appropriate test(s) to be used in the 'Rita' function.

**Usage**
MasterTest(c, data, alpha = 0.05, j = 1)

**Arguments**
- **c**: Input specifying the test to run (scalar)
- **data**: The data of a univariate distribution for which the test statistic is computed (vector)
- **alpha**: The two-sided decision threshold used for hypothesis-testing (scalar)
- **j**: The # hypotheses tested; used to compute a Bonferroni correction, if applicable; should remain at its default if multiple testing is not an issue (scalar)

**Value**
An results object specific to the test designated with the ’c’ argument (list)

**Examples**
values <- rnorm(100)
x <- MasterTest(c = 1, data = values)

---

MasterXform

**Master Transformation Function**

**Description**
This is a master function used to perform the appropriate transformation(s) within the 'Rita' function.

**Usage**
MasterXform(c, data)

**Arguments**
- **c**: Input specifying the test to run (scalar)
- **data**: The data of a univariate distribution for which the test statistic is computed (vector)
Value

Output from the appropriate subfunction (list)

Examples

```r
values <- rnorm(100)
x <- MasterXform(c = 2, data = values)
```

---

**popSD**

*Converts Sample Standard Deviations into Population Equivalents*

Description

This function converts a sample standard deviation (SD) input into the population equivalent. This code is vectorized to convert several sample standard deviations for univariate distributions of identical sample-sizes, if desired.

Usage

```r
popSD(s, n)
```

Arguments

- **s**: The sample SD(s) (vector)
- **n**: The sample-size for each SD to be converted (vector)

Value

The population SD(s) (vector)

References


Examples

```r
values <- rnorm(100)
x <- popSD(s = sd(values), n = 100)
```
### rankitXform

**Rankit Transformation**

#### Description

This function transforms data via the Rankit, a member of the families of 'rank-based normalization methods' and 'empirical normal quantile transformations' employed in both the social sciences and quantitative genetics.

#### Usage

```r
rankitXform(sample)
```

#### Arguments

- `sample` The input data (vector)

#### Value

The Rankit-transformed data (vector)

#### References


#### Examples

```r
values <- rnorm(100)
x <- rankitXform(values)
```

### Rita

**Rita**

#### Description

R Exploratory Data Analysis (REDA; pronounced "rita") summarizes an input dataset by the M, SD + 5-number summary + third and fourth moments and visualizes the data according to an algorithm or as specified by the user. In addition, Rita will provide the results of one or several normality tests. Lastly, Rita normalizes the dataset with several methods and provides visualizations of the best performing method to the user.
Usage

Rita(
data,  
test = 1,  
xform = 1,  
alpha = 0.05,  
j = 1,  
autoPlot = T,  
histPlot = F,  
densPlot = F,  
stripPlot = F,  
violinPlot = F,  
xformPlot = F,  
return = T,  
seed = 10  
)

Arguments

data
Input dataset (matrix, dataframe, or vector). For a univariate distribution, submit a vector or a subsetted matrix or dataframe. If results for many univariate distributions are desired, submit a matrix or dataframe with each column representing a given variable if all distributions are of the same sample-size. If not, it is recommended to call Rita repeatedly for each variable.

test
Desired normality test (scalar). By default (test = 1), Rita will present the results of the Shapiro-Wilk test to the user.

test = 1: Shapiro-Wilk (SW)
test = 2: Kolmogorov-Smirnov/Lilliefors (KSL)
test = 3: Anderson-Darling (AD)
test = 4: Jarque-Bera (JB)
test = 5: D’Agostino Pearson Omnibus (DP)
test = 6: Chi-square test (chiSq)
test = 7: Results of all tests for the best performing transformation

The order of the tests printed corresponds to the order of the variables stored within the input dataset.

xform
Desired normalization method (scalar). By default (xform = 1), Rita will assess which method performs best and (a.) return the transformed data to the user, and (b.) visualize the data according to the settings of the plot argument.

Please note that, per the recommendations of Osborne (2002), a constant is added prior to logarithmic and inverse transformations to ensure that the minimum value is anchored at 1, and prior to the square-root transformation to ensure a left anchor of 0.

Similarly, the arc-sine and logit transformations are applied after converting the units, if needed, to ensure that variables are bounded between 0 and 1.

The "best performing" method is identified by comparing goodness-of-fit to the straight line of the QQ plot for the quantiles of the data normalized by a given
method and the standard normal distribution. If a tie is present between transform-
ations for a variable, one of the best performing transformations is arbitrarily
selected.

xform = 1: Best performing method is presented (excluding the Rankit)
xform = 2: Logarithmic transform
xform = 3: Inverse/reciprocal transform
xform = 4: Square-root transform
xform = 5: Arc-sine transform
xform = 6: Logit transform
xform = 7: Rankit transform

alpha The two-sided decision threshold used for normality hypothesis-testing (scalar)
j The # hypotheses tested; used to compute a Bonferroni correction, if applicable; should remain at its default if multiple testing is not an issue (scalar)
autoPlot Desired plotting method (boolean). By default (plot = 1), the visualization will be implicitly chosen based on extracted features of the dataset.
When autoPlot = F, values of additional plotting arguments are used to determine the visualizations provided to the user.
When autoPlot = T:
Histograms are always generated for discrete data.
Density plots are always generated for continuous data.
Strip plots are generated when the # distinct values are <= 20 AND the # data-
points are 15 <= x <= 150.
Violin plots are instead generated in lieu of the strip plots created when the above conditions are not met.
Lastly, density plots for each (transformed*) variable are generated.
*Transformed variables correspond to the choice made by the user for the xform argument or to the best-performing transformation for each variable when xform = 1.

All plots are drawn in the R console and saved as plotting objects.

histPlot Whether to generate histograms for each variable (boolean).
densPlot Whether to generate density plots for each variable (boolean).
stripPlot Whether to draw strip plots for each variable (boolean).
violinPlot Whether to draw violin plots for each variable (boolean).
xformPlot Whether to draw density plots for each transformed variable (boolean).
return Whether to return the transformed variables of the best performing method (return = T; default), or the cleaned, untransformed variables eligible for transfor-
mation (return = F) (boolean).

Details

Any rows with missing values (NAs) are removed for calculation purposes; if desired, incomplete records should be imputed or removed with subsetting prior to calling Rita. In addition, note that any columns not numeric type or coercible to numeric are excluded from analysis, as are any numeric columns with 2 distinct values or less.
Description

Adjusted Fisher-Pearson Skewness Coefficient with Sample-size Correction Factor

Usage

`skewCoeff(data, sd)`

Arguments

- `data`: The data for which skewness is computed (vector)
- `sd`: The population standard deviation, used to compute skewness (scalar)

Value

The skewness value (scalar)

Examples

```r
values <- rnorm(100)
x <- skewCoeff(data = values, sd = sd(values))
```
**squareXform**  
*Square-root Transformation*

**Description**  
This function left anchors the minimum value to 0 per the recommendations of Osborne (2002) and subsequently transforms the data by taking the square-root of each value.

**Usage**  
```
squareXform(sample)
```

**Arguments**  
- `sample`: The input data (vector)

**Value**  
The square-transformed data (vector)

**References**  


**Examples**  
```
values <- rnorm(100)
x <- squareXform(values)
```

---

**SWTest**  
*Shapiro-Wilk Test*

**Description**  
This function is a wrapper for shapiro.test() from the stats package. Options added include an ability to toggle a Bonferoni correction for significance, a corresponding significance flag, and reorganized output to facilitate integration with the Rita package.

**Usage**  
```
SWTest(data, alpha = 0.05, j = 1, warn = T)
```
Arguments

- **data**: Data of a univariate distribution for which the test statistic is computed (vector)
- **alpha**: The two-sided decision threshold used for hypothesis-testing
- **j**: The # hypotheses tested; used to compute a Bonferroni correction, if applicable; should remain at its default if multiple testing is not an issue (scalar)
- **warn**: Used for printing a warning message when resampling is performed on sample-sizes > 5000 or when testing is terminated for N < 3 (boolean)

Details

Note that when the sample-size of the input vector is > 5000, resampling with replacement is used to proceed with hypothesis-testing with a vector of 5000 elements. When N < 3, testing is terminated.

Value

An object including the test statistic, p-value, and a significance flag (list)

References


Examples

```r
values <- rnorm(100)
x <- SWTest(data = values)
```
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