Package ‘MVN’

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Type Package

Title Multivariate Normality Tests

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Description Performs multivariate normality tests and graphical approaches and
implements multivariate outlier detection and univariate normality of marginal
distributions through plots and tests (Korkmaz et al, (2014), <https://journal.r-

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hztEst

*Deprecated Function for Henze-Zirkler's Multivariate Normality Test*

**Description**

Please use 'mvn' function instead

**Usage**

```
hztEst(data, cov = TRUE, qqplot = FALSE)
```

**Arguments**

- **data**: a numeric matrix or data frame
- **cov**: If TRUE covariance matrix is normalized by n, if FALSE it is normalized by n-1
- **qqplot**: TRUE it creates chi-square Q-Q plot

mardiaTest

*Deprecated Function for Mardia’s Multivariate Normality Test*

**Description**

Please use 'mvn' function instead

**Usage**

```
mardiaTest(data, cov = TRUE, qqplot = FALSE)
```

**Arguments**

- **data**: a numeric matrix or data frame
- **cov**: If TRUE covariance matrix is normalized by n, if FALSE it is normalized by n-1
- **qqplot**: TRUE it creates chi-square Q-Q plot
Describes multivariate normality tests, including Marida, Royston, Henze-Zirkler, Dornik-Haansen, E-Statistics, and graphical approaches and implements multivariate outlier detection and univariate normality of marginal distributions through plots and tests.

Usage

```r
mvn(data, subset = NULL, mvnTest = c("mardia", "hz", "royston", "dh", "energy"), covariance = TRUE, tol = 1e-25, alpha = 0.5, scale = FALSE, desc = TRUE, transform = "none", R = 1000, univariatetest = c("sw", "CVM", "Lillie", "SF", "AD"), univariatePlot = "none", multivariatePlot = "none", multivariateOutlierMethod = "none", showOutliers = FALSE, showNewData = FALSE)
```

Arguments

- `data` a numeric matrix or data frame
- `subset` define a variable name if subset analysis is required
- `mvnTest` select one of the MVN tests. Type "mardia" for Mardia’s test, "hz" for Henze-Zirkler’s test, "royston" for Royston’s test, "dh" for Doornik-Hansen’s test and energy for E-statistic. See details for further information.
- `covariance` this option works for "mardia" and "royston". If TRUE covariance matrix is normalized by n, if FALSE it is normalized by n-1
- `tol` a numeric tolerance value which is used for inversion of the covariance matrix (default = 1e-25)
- `alpha` a numeric parameter controlling the size of the subsets over which the determinant is minimized. Allowed values for the alpha are between 0.5 and 1 and the default is 0.5.
- `scale` if TRUE scales the columns of data
- `desc` a logical argument. If TRUE calculates descriptive statistics
- `transform` select a transformation method to transform univariate marginal via logarithm ("log"), square root ("sqrt") and square ("square").
- `R` number of bootstrap replicates for Energy test, default is 1000.
- `univariatetest` select one of the univariate normality tests, Shapiro-Wilk ("SW"), Cramer-von Mises ("CVM"), Lilliefors ("Lillie"), Shapiro-Francia ("SF"), Anderson-Darling ("AD")
- `univariatePlot` select one of the univariate normality plots, Q-Q plot ("qq"), histogram ("histogram"), box plot ("box"), scatter ("scatter")
multivariatePlot
   "qq" for chi-square Q-Q plot, "persp" for perspective plot, "contour" for contour plot

multivariateOutlierMethod
   select multivariate outlier detection method, "quan" quantile method based on Mahalanobis distance and "adj" adjusted quantile method based on Mahalanobis distance

showOutliers if TRUE prints multivariate outliers
showNewData if TRUE prints new data without outliers

Details

If mvnTest = "mardia", it calculate the Mardia’s multivariate skewness and kurtosis coefficients as well as their corresponding statistical significance. It can also calculate corrected version of skewness coefficient for small sample size (n< 20). For multivariate normality, both p-values of skewness and kurtosis statistics should be greater than 0.05. If sample size less than 20 then p.value.skew should be used as significance value of skewness instead of p.value.skew. If there are missing values in the data, a listwise deletion will be applied and a complete-case analysis will be performed.

If mvnTest = "hz", it calculate the Henze-Zirkler’s multivariate normality test. The Henze-Zirkler test is based on a non-negative functional distance that measures the distance between two distribution functions. If the data is multivariate normal, the test statistic HZ is approximately lognormally distributed. It proceeds to calculate the mean, variance and smoothness parameter. Then, mean and variance are lognormalized and the p-value is estimated. If there are missing values in the data, a listwise deletion will be applied and a complete-case analysis will be performed.

If mvnTest = "royston", it calculate the Royston’s multivariate normality test. A function to generate the Shapiro-Wilk’s W statistic needed to feed the Royston’s H test for multivariate normality. However, if kurtosis of the data greater than 3 then Shapiro-Francia test is used for leptokurtic samples else Shapiro-Wilk test is used for platykurtic samples. If there are missing values in the data, a listwise deletion will be applied and a complete-case analysis will be performed.

If mvnTest = "dh", it calculate the Doornik-Hansen’s multivariate normality test. The code is adapted from asbio package (Aho, 2017).

Value

multivariateNormality corresponding multivariate normality test statistics and p-value
univariateNormality corresponding univariate normality test statistics and p-value
Descriptives Descriptive statistics
multivariateOutliers multivariate outliers
newData new data without multivariate outliers
multivariate normality plots, Q-Q, perspective or contour
chi-square Q-Q plot for multivariate outliers
univariate normality plots, Q-Q plot, histogram, box plot, scatter
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References


Examples
result = mvn(data = iris[-4], subset = "Species", mvnTest = "hz",
univariateTest = "AD", univariatePlot = "histogram",
multivariatePlot = "qq", multivariateOutlierMethod = "adj",
showOutliers = TRUE, showNewData = TRUE)

### Multivariate Normality Result
result$multivariateNormality

### Univariate Normality Result
result$univariateNormality

### Descriptives
result$Descriptives

### Multivariate Outliers
result$multivariateOutliers

### New data without multivariate outliers
result$newData

# Note that this function also creates univariate histograms,
# multivariate Q-Q plots for multivariate normality assessment
# and multivariate outlier detection.

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**roystonTest**

*Deprecated Function for Royston’s Multivariate Normality Test*

**Description**

Please use 'mvn' function instead

**Usage**

roystonTest(data, qqplot = FALSE)

**Arguments**

- **data**: a numeric matrix or data frame
- **qqplot**: TRUE it creates chi-square Q-Q plot
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