

# Package ‘parody’

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**Title** Parametric And Resistant Outlier DYtection

**Version** 1.69.0

**Description** Provide routines for univariate and multivariate outlier detection with a focus on parametric methods, but support for some methods based on resistant statistics.

**Depends** R (>= 3.5.0), tools, utils

**Suggests** knitr, BiocStyle, testthat, rmarkdown

**License** Artistic-2.0

**VignetteBuilder** knitr

**biocViews** MultipleComparison

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**Author** Vince Carey [aut, cre] (ORCID: <<https://orcid.org/0000-0003-4046-0063>>)

**Maintainer** Vince Carey <stvjc@channing.harvard.edu>

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|           |   |
|-----------|---|
| box.scale | <i>calibrated scaling inlier multiplier radius for various outlier detection approaches</i> |
|-----------|---|

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**Description**

calibrated scaling inlier multiplier radius for various outlier detection approaches

**Usage**

```
box.scale(n, alpha=0.05)
```

**Arguments**

|       |       |
|-------|-------|
| n     | n     |
| alpha | alpha |

**Author(s)**

Vince Carey <stvjc@channing.harvard.edu>

**Examples**

```
box.scale(20)
```

---

|          |   |
|----------|---|
| bushfire | <i>satellite data on bushfire scars</i> |
|----------|---|

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**Description**

satellite data on bushfire scars

**Usage**

```
data(bushfire)
```

**Format**

The format is: num [1:38, 1:5] 111 113 113 110 101 93 92 94 94 100 ...

**Details**

Satellite measurements on five frequency bands corresponding to each of 38 pixels.

**Source**

Maronna RA and Yohai VJ (1995) JASA 90:330.

**Examples**

```
data(bushfire)
mv.calout.detect(bushfire)
```

---

|               |   |
|---------------|---|
| calout.detect | <i>interface to modular calibrated outlier detection system</i> |
|---------------|---|

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**Description**

Various classical and resistant outlier detection procedures are provided in which the outlier misclassification rate for Gaussian samples is fixed over a range of sample sizes.

**Usage**

```
calout.detect(x, alpha = 0.05, method = c("GESD", "boxplot", "medmad",
  "shorth", "hybrid"), k = ((length(x)%2) * floor(length(x)/2) +
  (1 - (length(x)%2)) * (length(x)/2 - 1)), scaling, ftype,
  location, scale, gen.region = function(x, location, scale,
  scaling, alpha) {
  g <- scaling(length(x), alpha)
  location(x) + c(-1, 1) * g * scale(x)
})
```

**Arguments**

|         |  |
|---------|--|
| x       | data vector, NAs not allowed   |
| alpha   | outlier mislabeling rate for Gaussian samples  |
| method  | one of c("GESD", "boxplot", "medmad", "shorth"); the first selects generalized extreme studentized deviate (Rosner, 1983); the second selects calibrated boxplot rules; the third selects the method of Hampel in which the sample median is used for location estimation, and the median absolute deviation is used for scale; and the fourth selects Rousseeuw's rule, with the midpoint of the shortest half sample used as location estimator, and the length of this shortest half sample used as scale estimator.<br>An important characteristic of the GESD procedure is that the critical values for outlier labeling are calibrated to preserve the overall Type I error rate of the procedure given that there will be k tests, whether or not any outliers are present in the data. |
| k       | for GESD, the prespecified upper limit on the number of outliers suspected in the data; defaults to "half" the sample size.  |
| scaling | for resistant methods, scaling is a sample-size dependent function that tells how many multiples of the scale estimate should be laid off on each side of the location estimate to demarcate the inlier region; see Davies and Gather (1993) for the general formulation. The main contribution of this program consists in the development of scaling functions that "calibrate" outlier detection in Gaussian  |

samples. The scaling function is assumed to take two arguments,  $n$  and  $\alpha$ , and it should return a real number.

If `method=="boxplot"`, the default value `scaling=box.scale` will confine the probability of erroneous detection of one or more outliers in a pure Gaussian sample to  $\alpha$ . The use of `scaling=function(n,alpha) 1.5` gives the standard boxplot outlier labeling rule.

If `method=="medmad"`, the use of `scaling=hamp.scale.4` will confine the outlier mislabeling rate to  $\alpha$ ; whereas the use of `scaling=function(n,alpha) 5.2` gives Hampel's rule (Davies and Gather, 1993, p. 790).

If `method=="shorth"`, the default value `scaling=shorth.scale` will confine the outlier mislabeling rate to  $\alpha$ .

|                         |   |
|-------------------------|---|
| <code>f\$type</code>    | The type of "fourth" calculation; the standard definition of the fourth uses $0.5 * \text{floor}((n + 3)/2)$ to obtain the sortile of the fourth value; Hoaglin and Iglewicz (1987) give an "ideal" definition of the fourth which reduces the dependence of boxplot-based outlier detection performance (in small samples) on the quantity $n \bmod 4$ . |
| <code>location</code>   | a function on a vector returning a location estimate  |
| <code>scale</code>      | a function on a vector returning a scale estimate   |
| <code>gen.region</code> | a function of $x$ , <code>location</code> , <code>scale</code> , <code>scaling</code> , $\alpha$ that returns the inlier region as a 2-vector   |

### Value

a list with components `ind` (indices of outliers in the input vector) `val` (values of these components) and `outlier.region`, which is only defined for the resistant methods.

### References

Davies and Gather (1993 JASA), Rousseeuw and Leroy (1988 Stat Neer), Rosner (1983 Technom), Hoaglin and Iglewicz (1987 JASA), Carey, Walters, Wager and Rosner (1997 Technom)

### Examples

```
lead <- c(83, 70, 62, 55, 56, 57, 57, 58, 59, 50, 51, 52, 52, 52, 54, 54, 45, 46, 48,
         48, 49, 40, 40, 41, 42, 42, 44, 44, 35, 37, 38, 38, 34, 13, 14)
```

```
calout.detect(lead,alpha=.05,method="boxplot",f$type="ideal")
calout.detect(lead,alpha=.05,method="GESD",k=5)
calout.detect(lead,alpha=.05,method="medmad",scaling=hamp.scale.3)
calout.detect(lead,alpha=.05,method="shorth")
```

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mv.calout.detect      *calibrated multivariate outlier detection*

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### Description

interface to a parametric multivariate outlier detection algorithm

### Usage

```
mv.calout.detect(x, k = min(floor((nrow(x) - 1)/2), 100), Ci = C.unstr,  
lamfun = lams.unstr, alpha = 0.05, method = c("parametric",  
"rocke", "kosinski.raw", "kosinski.exch")[1], ...)
```

### Arguments

|        |   |
|--------|---|
| x      | data matrix   |
| k      | upper bound on number of outliers; defaults to just less than half the sample size  |
| Ci     | function computing Ci, the covariance determinant ratio excluding row i. At present, sole option is C.unstr (Caroni and Prescott 1992 Appl Stat). |
| lamfun | function computing lambda, the critical values for Ci   |
| alpha  | false outlier labeling rate   |
| method | string identifying algorithm to use   |
| ...    | reserved for future use   |

### Details

bushfire is a dataset distributed by Kosinski to illustrate his method.

### Value

a list with components

|       |                          |
|-------|--------------------------|
| inds  | indices of outlying rows |
| vals  | values of outlying rows  |
| k     | input parameter k        |
| alpha | input parameter alpha    |

### Author(s)

VJ Carey

### References

C. Caroni and P. Prescott, Journal of the Royal Statistical Society. Series C (Applied Statistics), Vol. 41, No. 2 (1992), pp. 355-364

**Examples**

```
data(tcost)
mv.calout.detect(tcost)
data(bushfire)
mv.calout.detect(bushfire)
```

---

|        |  |
|--------|--|
| shorth | <i>one-dimensional MVE (min. vol. ellipsoid)</i> |
|--------|--|

---

**Description**

generalized length of shortest-half sample

**Usage**

```
shorth(x, Alpha=0.5)
```

**Arguments**

|       |  |
|-------|--|
| x     | data vector, no NAs  |
| Alpha | minimum fraction of data to be covered by scale estimator. if Alpha == 0.5, the shorth is calculated |

**Value**

a list, say L, with components

|                       |  |
|-----------------------|--|
| shorth                | a 2-vector with endpoints of the shortest Alpha-sample   |
| length.shorth         | see previous return component L\$shorth[2]-L\$shorth[1]  |
| midpt.shorth          | mean(L[["shorth"]])  |
| meanshorth            | mean of values in the shorth, studied by Andrews et al (1972) as a location estimator  |
| correction.parity.dep | correction factor to be applied to achieve approximate unbiasedness and diminish small-sample parity dependence; L[["shorth"]] * L[["correction"]] is approximately unbiased for the Gaussian standard deviation, for $0 < \text{Alpha} < 1$ .   |
| bias.correction.gau.5 | correction factor to be applied along with correction.parity.dep when Alpha = .5; empirically derived bias correction useful for $10 < N < 2000$ and possibly beyond. To use, divide: (L[["shorth"]] * L[["correction"]] / L[["bias.corr"]]) is approximately unbiased for Gaussian standard deviation, when Alpha=.5. |
| Alpha                 | coverage fraction used   |

**References**

Rousseeuw and Leroy, Stat Neer (1988), Gruebel, Ann Stat (1988)

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|       |  |
|-------|--|
| tcost | <i>Data on milk transportation costs, from Johnson and Wichern, Applied Multivariate Statistical Analysis, 3rd edition</i> |
|-------|--|

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**Description**

Multivariate data on milk transportation costs

**Usage**

```
data(tcost)
```

**Format**

The format is: num [1:36, 1:3] 16.44 7.19 9.92 4.24 11.2 ...

- attr(\*, "dimnames")=List of 2

.. \$: chr [1:36] "1" "2" "3" "4" ...

.. \$: chr [1:3] "fuel" "repair" "capital"

**Details**

Extract from Johnson and Wichern example dataset on milk transportation.

**Source**

Johnson and Wichern, Applied Multivariate Statistical Analysis, 3rd edition, p263

**Examples**

```
data(tcost)
mv.calout.detect(tcost)
```

---

|         |  |
|---------|--|
| tukeyor | <i>calibrated outlier region based on various algorithms</i> |
|---------|--|

---

**Description**

calibrated outlier region based on various algorithms

**Usage**

```
tukeyor(x, alpha=0.05, g=box.scale(length(x), alpha = alpha), ftype="ideal")
```

**Arguments**

|                   |                   |
|-------------------|-------------------|
| x                 | x                 |
| alpha             | alpha             |
| g                 | g                 |
| f <sub>type</sub> | f <sub>type</sub> |

**Author(s)**

Vince Carey <stvjc@channing.harvard.edu>

**Examples**

```
data(tcost)
apply(tcost, 2, tukeyor)
```

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