

# Package ‘MultipleBubbles’

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**Title** Test and Detection of Explosive Behaviors for Time Series

**Author** Pedro Araujo <pharaujo1094@gmail.com>  
Gustavo Lacerda <gustavolacerdas@gmail.com>  
Peter C.B. Phillips <peter.phillips@yale.edu>  
Shu-Ping Shi <shuping.shi@mq.edu.au>

**Maintainer** Pedro Araujo <pharaujo1094@gmail.com>

## Description

Provides the Augmented Dickey-Fuller test and its variations to check the existence of bubbles (explosive behavior) for time series, based on the article by Peter C. B. Phillips, Shu-Ping Shi and Jun Yu (2015a) <[doi:10.1111/iere.12131](https://doi.org/10.1111/iere.12131)>. Some functions may take a while depending on the size of the data used, or the number of Monte Carlo replications applied.

**License** GPL (>= 2)

**Imports** MASS (>= 7.3), foreach (>= 1.4.4), stats

**LazyData** TRUE

**RoxygenNote** 6.1.0

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ADF\_FL                      *Augmented Dickey-Fuller Statistic*

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**Description**

Calculate the Augmented Dickey-Fuller Statistic with a fixed lag order .

**Usage**

```
ADF_FL(y, adflag = 0, mflag = 1)
```

**Arguments**

y	the time series to be used.
adflag	is the lag order.
mflag	1 for ADF with constant and whithout trend, 2 for ADF with constant and trend and 3 for ADF without constant and trend.

**References**

Phillips, P.C. & Shi, S. & Yu, J. (2015a). "Testing for Multiple Bubbles: Historical Episodes of Exuberance and Collapse in the S&P 500". *SSRN Electronic Journal*.

**Examples**

```
y <- rnorm(10)
ADF_FL(y, adflag = 1, mflag = 2)
```

---

ADF\_IC                      *Augmented Dickey-Fuller Statistic by AIC or BIC*

---

**Description**

Calculate the Augmented Dickey-Fuller Statistic with lag order selected by AIC or BIC.

**Usage**

```
ADF_IC(y, adflag, mflag, IC)
```

**Arguments**

y	the time series to be used.
adflag	the maximum lag order.
mflag	1 for ADF with constant and whithout trend, 2 for ADF with constant and trend and 3 for ADF without constant and trend.
IC	1 for AIC and 2 for BIC.

## References

Phillips, P.C. & Shi, S. & Yu, J. (2013). "Testing for Multiple Bubbles: Historical Episodes of Exuberance and Collapse in the S&P 500". *SSRN Electronic Journal*.

## Examples

```
y <- rnorm(10)
ADF_IC(y, adflag = 1, mflag = 2, IC = 1)
ADF_IC(y, adflag = 1, mflag = 2, IC = 2)
```

---

badf	<i>Backward Augmented Dickey-Fuller Sequence.</i>
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## Description

In this program, we calculate critical value sequences for the backward ADF statistic sequence for a matrix generated from a standard Normal distribution.

## Usage

```
badf(m, t, adflag = 0, mflag = 1)
```

## Arguments

m	Number of Monte Carlo replications. Must be bigger than 2.
t	Sample size. Must be bigger than 2.
adflag	Number of lags to be included in the ADF Test. Default equals 0.
mflag	1 for ADF with constant and without trend, 2 for ADF with constant and trend and 3 for ADF without constant and trend.

## References

Phillips, P.C. & Shi, S. & Yu, J. (2015a). "Testing for Multiple Bubbles: Historical Episodes of Exuberance and Collapse in the S&P 500". *SSRN Electronic Journal*.

## Examples

```
foo <- badf(m = 100, t = 50, adflag = 1, mflag = 1)
plot(foo$quantiles[2,], type = 'l')
```

---

bsadf *Critical values for backward SADF statistic sequence.*

---

### Description

Calculate critical value sequences for the backward sup ADF statistic sequence using Monte Carlo simulations for a sample generated from a Normal distribution.

### Usage

```
bsadf(m, t, adflag = 0, mflag = 1)
```

### Arguments

m	Number of Monte Carlo Simulations
t	Sample size.
adflag	is the lag order.
mflag	1 for ADF with constant and whithout trend, 2 for ADF with constant and trend and 3 for ADF without constant and trend.#' @keywords AugmentedDickey-FullerTest backwardSADF MonteCarlo.

### References

Phillips, P.C. & Shi, S. & Yu, J. (2015a). "Testing for Multiple Bubbles: Historical Episodes of Exuberance and Collapse in the S&P 500". *SSRN Electronic Journal*.

### Examples

```
foo <- bsadf(m = 20, t = 50, adflag = 1, mflag = 2)
plot(foo$quantiles[2,], type = 'l')
```

---

DGP *Random walk.*

---

### Description

Generate a random walk with drift  $1/n$ .

### Usage

```
DGP(n, niter)
```

### Arguments

n	sample size. Number of rows in the generated matrix.
niter	number of columns in the generated matrix.

**Examples**

```
DGP(n = 100, niter = 10)
```

---

gsadf

*Critical values for generalized sup ADF statistic sequence.*

---

**Description**

Calculate critical value sequences for the generalized sup ADF statistic sequence using Monte Carlo simulations for a sample generated from a Normal distribution.

**Usage**

```
gsadf(m, t, adflag = 0, mflag = 1, swindow0 = floor(r0 * t))
```

**Arguments**

m	Number of Monte Carlo Simulations. Default equals 2000. Must be bigger than 2.
t	Sample size. Default equals 100. Must be bigger than 2.
adflag	Number of lags to be included in the ADF Test. Default equals 0.
mflag	1 for ADF with constant and without trend, 2 for ADF with constant and trend and 3 for ADF without constant and trend.
swindow0	Minimum window size.

**References**

Phillips, P.C. & Shi, S. & Yu, J. (2015a). "Testing for Multiple Bubbles: Historical Episodes of Exuberance and Collapse in the S&P 500". *SSRN Electronic Journal*.

**Examples**

```
foo <- gsadf(m = 20, t = 50)
quant <- rep(foo$quantiles[2], 100)
plot(quant, type = 'l')
```

---

sadf *Critical values for sup ADF statistic sequence.*

---

### Description

Calculate critical value sequences for the sup ADF statistic sequence using Monte Carlo simulations for a sample generated from a Normal distribution.

### Usage

```
sadf(m, t)
```

### Arguments

m Number of Monte Carlo Simulations. Default equals 2000. Must be bigger than 2.

t Sample size. Default equals 100. Must be bigger than 2.

### References

Phillips, P.C. & Shi, S. & Yu, J. (2015a). "Testing for Multiple Bubbles: Historical Episodes of Exuberance and Collapse in the S&P 500". *SSRN Electronic Journal*.

### Examples

```
foo <- sadf(m = 20, t = 50)
quant <- rep(foo$quantiles[2], 100)
plot(quant, type = 'l')
```

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sadf\_gsadf *Sup ADF and generalized sup ADF statistics for a time series.*

---

### Description

Calculate the sup ADF and the generalized sup ADF statistics using the backward ADF statistic sequence and the backward SADF statistic sequence, respectively.

### Usage

```
sadf_gsadf(y, adflag, mflag, IC, parallel = FALSE)
```

**Arguments**

y	the time series.
adflag	the lag order for the ADF test.
mflag	1 for ADF with constant and without trend, 2 for ADF with constant and trend and 3 for ADF without constant and trend.
IC	1 for AIC and 2 for BIC.
parallel	If TRUE, uses parallel computing for the loop. If the data is large it could be faster, but usually it is slower for small data.

**References**

Phillips, P.C. & Shi, S. & Yu, J. (2015a). "Testing for Multiple Bubbles: Historical Episodes of Exuberance and Collapse in the S&P 500". *SSRN Electronic Journal*.

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sp_data	<i>S&amp;P 500 data.</i>
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**Description**

the S&P 500 price dividend ratio from January 1871 to December 2010.

**Format**

A vector with the S&P 500 price dividend ratio.

**References**

Phillips, P.C. & Shi, S. & Yu, J. (2015a). "Testing for Multiple Bubbles: Historical Episodes of Exuberance and Collapse in the S&P 500". *SSRN Electronic Journal*.

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