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Type Package

Title Tempered Stable Subordinators and Related Distributions

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Date 2026-09-06

Description Contains methods for the simulation of tempered stable subordinators and related distributions. Including classical tempered stable (both finite and infinite variation), rapidly decreasing tempered stable, truncated stable, truncated tempered stable, generalized Dickman, truncated gamma, generalized gamma, and p-gamma. For details, see Dassios et al (2019) [<doi:10.1017/jpr.2019.6>](https://doi.org/10.1017/jpr.2019.6), Dassios et al (2020) [<doi:10.1145/3368088>](https://doi.org/10.1145/3368088), Grabchak (2021) [<doi:10.1016/j.spl.2020.109015>](https://doi.org/10.1016/j.spl.2020.109015), Grabchak (2026) [<doi:10.48550/arXiv.2604.17732>](https://doi.org/10.48550/arXiv.2604.17732).

Imports copula, gsl, stats, tweedie

License GPL (>= 3)

NeedsCompilation yes

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SubTS-package	<i>Tempered Stable Subordinators and Related Distributions</i>
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Description

Contains methods for the simulation of tempered stable subordinators and related distributions. Including classical tempered stable (both finite and infinite variation), rapidly deceasing tempered stable, truncated stable, truncated tempered stable, generalized Dickman, truncated gamma, generalized gamma, and p-gamma. For details, see Dassios et al (2019) <doi:10.1017/jpr.2019.6>, Dassios et al (2020) <doi:10.1145/3368088>, Grabchak (2021) <doi:10.1016/j.spl.2020.109015>, Grabchak (2026) <doi:10.48550/arXiv.2604.17732>.

Details

Package: SubTS
Type: Package
Title: Tempered Stable Subordinators and Related Distributions
Version: 2.0
Date: 2026-09-06
Authors@R: c(person("Michael", "Grabchak", role = c("aut", "cre"), email = "mgrabcha@charlotte.edu"), person("Lijuan",
Description: Contains methods for the simulation of tempered stable subordinators and related distributions. Including class
Imports: copula, gsl, stats, tweedie
License: GPL (>= 3)
Author: Michael Grabchak [aut, cre], Lijuan Cao [aut]
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getk1	Constant K_1
getk2	Constant K_2
rCTSM	Simulation of Fully Left Skewed CTS Distributions
rCTSP	Simulation of Fully Right Skewed CTS Distributions
rDickman	Simulation from the generalized Dickman distribution
rF1	Simulation from f_1
rF2	Simulation from f_2
rGGa	Simulates from the generalized gamma distribution
rPGamma	Simulation from p-gamma distributions.
rPRDTS	Simulation from p-RDTS distributions.
rSubCTS	Simulation of CTS Subordinators
rTrunGamma	Simulation from the truncated gamma distribution
rTrunS	Simulation from the truncated stable distribution
rTrunTS	Simulation from the truncated tempered stable distribution.
simCondS	Simulation from a conditioned stable distribution.
simTandW	Simulation of hitting time and overshoot.

Author(s)

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References

- A. Dassios, Y. Qu, J.W. Lim (2019). Exact simulation of generalised Vervaat perpetuities. *Journal of Applied Probability*, 56(1):57-75.
- A. Dassios, Y. Qu, J.W. Lim (2020). Exact simulation of a truncated Levy subordinator. *ACM Transactions on Modeling and Computer Simulation*, 30(10), 17.
- M. Grabchak (2016). *Tempered Stable Distributions: Stochastic Models for Multiscale Processes*. Springer, Cham.
- M. Grabchak (2021). An exact method for simulating rapidly decreasing tempered stable distributions. *Statistics and Probability Letters*, 170: Article 109015.
- M. Grabchak (2026). Exact Simulation from Tempered Stable Distributions with Infinite Variation ($\alpha \geq 1$). <doi 10.48550/arXiv.2604.17732>.

Examples

```

rPRDTS(20, 2, 1, .7, 2)
rPRDTS(20, 2, 1, 0, 2)
rPRDTS(20, 2, 1, -.7, 2)
rDickman(10, 1)
rTrunGamma(10, 2, 1)
rPGamma(20, 2, 2, 2)
rTrunS(10, 2, .6)
rTrunTS(10, 2, 2, .6)
rCTSP(10,1.5,1,1)
rCTSM(10,1.5,1,1)

```

dF1

*Pdf for f_1***Description**

Evaluates the pdf $f_1(x)$ introduced in Grabchak (2021).

Usage

```
dF1(x, a, p)
```

Arguments

x	Vector of real numbers.
a	Parameter ≥ 0 .
p	Parameter > 1 .

Details

Evaluates the pdf

$$f_1(x) = \exp(-x^p) x^{(-1-a)} / K_1, x > 1$$

where K_1 is a normalizing constant. This distribution is needed to simulate p-RDTS random variables.

Value

Returns a vector of real numbers corresponding to the values of $f_1(x)$.

Author(s)

Michael Grabchak and Lijuan Cao

References

M. Grabchak (2021). An exact method for simulating rapidly decreasing tempered stable distributions. Statistics and Probability Letters, 170: Article 109015.

Examples

```
x = (10:20)/10
dF1(x, .5, 2)
```

dF2	<i>Pdf for f_2</i>
-----	--------------------

Description

Evaluates the pdf $f_2(x)$ introduced in Grabchak (2021).

Usage

```
dF2(x, a, p)
```

Arguments

x	Vector of real numbers.
a	Parameter in $[0,1)$.
p	Parameter >1 .

Details

Evaluates the pdf

$$f_2(x) = (\exp(-x^p) - \exp(-x)) * x^{(-1-a)} / K_2, 0 < x < 1$$

where K_2 is a normalizing constant. This distribution is needed to simulate p-RDTS random variables.

Value

Returns a vector of real numbers corresponding to the values of $f_2(x)$.

Author(s)

Michael Grabchak and Lijuan Cao

References

M. Grabchak (2021). An exact method for simulating rapidly decreasing tempered stable distributions. Statistics and Probability Letters, 170: Article 109015.

Examples

```
x = (0:10)/10
dF2(x, .5, 1.5)
```

dGGa

*Pdf of the generalized gamma distribution***Description**

Evaluates the pdf of the generalized gamma distribution.

Usage

```
dGGa(x, a, p, b)
```

Arguments

x	Vector of real numbers.
a	Parameter >0.
p	Parameter >0.
b	Parameter >0.

Details

Evaluates the pdf of the generalized gamma distribution with density

$$g(x) = \exp(-b \cdot x^p) \cdot x^{a-1} / K_3, \quad x > 0,$$

where K_3 is a normalizing constant. This distribution is needed to simulate p-RDTS random variables with negative alpha values.

Value

Returns a vector of real numbers corresponding to the values of $g(x)$.

Author(s)

Michael Grabchak and Lijuan Cao

References

M. Grabchak (2021). An exact method for simulating rapidly decreasing tempered stable distributions. *Statistics and Probability Letters*, 170: Article 109015.

E.W. Stacy (1962) A generalization of the gamma distribution. *Annals of Mathematical Statistics*, 33(3):1187-1192.

Examples

```
x = (0:20)/10
dGGa(x, 2.5, 1.5, 3.1)
```

dSubCTS

*PDF of CTS subordinator***Description**

Evaluates the pdf of the classical tempered stable (CTS) subordinator. When $\alpha=0$ this is the pdf of the gamma distribution.

Usage

```
dSubCTS(x, alpha, c, ell)
```

Arguments

x	Vector of real numbers.
alpha	Parameter in $[0,1)$.
c	Parameter >0
ell	Tempering parameter >0

Details

Returns the pdf of a classical tempered stable subordinator. The distribution has Laplace transform $L(z) = \exp(c \int_0^\infty (e^{-xz}-1)e^{-x/\text{ell}} x^{-1-\alpha} dx), z>0$ and Levy measure $M(dx) = c e^{-x/\text{ell}} x^{-1-\alpha} 1(x>0)dx$.

Value

Returns a vector of real numbers corresponding to the values of pdf.

Note

Uses the method dtweedie in the Tweedie package.

Author(s)

Michael Grabchak and Lijuan Cao

References

M. Grabchak (2016). Tempered Stable Distributions: Stochastic Models for Multiscale Processes. Springer, Cham.

Examples

```
x = (0:20)/10
dSubCTS(x, .5, 1, 1.5)
```

getk1	<i>Constant K_1</i>
-------	----------------------------------

Description

Evaluates the constant K_1 , which is the normalizing constant for f_1 .

Usage

```
getk1(alpha, p)
```

Arguments

alpha	Parameter ≥ 0 .
p	Parameter > 1 .

Details

Evaluates

$$K_1 = \int_1^{\infty} \exp(-x^p) x^{-(1-\alpha)} dx.$$

This is needed to simulate p-RDTS random variables.

Value

Returns a positive real number.

Author(s)

Michael Grabchak and Lijuan Cao

References

M. Grabchak (2021). An exact method for simulating rapidly decreasing tempered stable distributions. Statistics and Probability Letters, 170: Article 109015.

Examples

```
getk1(1.5, 2.5)
```

getk2	<i>Constant K_2</i>
-------	---------------------

Description

Evaluates the constant K_2 , which is the normalizing constant for f_2 .

Usage

```
getk2(alpha, p)
```

Arguments

alpha	Parameter in $[0,1)$.
p	Parameter >1 .

Details

Evaluates

$$K_2 = \int_0^1 (\exp(-x^p) - \exp(-x)) x^{(-1-\alpha)} dx.$$

This is needed to simulate p-RDTS random variables.

Value

Returns a positive real number.

Author(s)

Michael Grabchak and Lijuan Cao

References

M. Grabchak (2021). An exact method for simulating rapidly decreasing tempered stable distributions. Statistics and Probability Letters, 170: Article 109015.

Examples

```
getk2(0.5, 2.5)
```

rCTSM

*Simulation of Fully Left Skewed CTS Distributions***Description**

Simulates from fully left skewed classical tempered stable (CTS) distributions in both the finite and infinite variation cases. When $\alpha=0$ this is the negative of the gamma distribution.

Usage

```
rCTSM(n, alpha, c, ell, epsilon = 0.5, p = 0.5)
```

Arguments

n	Number of observations.
alpha	Parameter in $[0,2)$.
c	Parameter >0 .
ell	Tempering parameter >0 .
epsilon	Tuning parameter in $(0,1)$. Only for $\alpha \geq 1$.
p	Tuning parameter in $(0,1)$. Only for $\alpha \geq 1$.

Details

Simulates from a fully left skewed CTS distribution. The distribution has moment generating function

$$M(z) = \exp\left(c \int_{-\infty}^0 (e^{xz}-1)e^{-x/\ell} x^{(-1-\alpha)} dx\right)$$

and Levy measure

$$M(dx) = c e^{(-|x|/\ell)} |x|^{(-1-\alpha)} 1(x<0)dx.$$

Value

Returns a vector of n random numbers.

Author(s)

Michael Grabchak and Lijuan Cao

References

M. Grabchak (2016). Tempered Stable Distributions: Stochastic Models for Multiscale Processes. Springer, Cham.

M. Grabchak (2026). Exact Simulation from Tempered Stable Distributions with Infinite Variation ($\alpha \geq 1$). <doi 10.48550/arXiv.2604.17732>.

Examples

```
rCTSM(20, 1.5, 1, 1)
```

rCTSP

*Simulation of Fully Right Skewed CTS Distributions***Description**

Simulates from fully right skewed classical tempered stable (CTS) distributions in both the finite and infinite variation cases. When $\alpha=0$ this is the gamma distribution.

Usage

```
rCTSP(n, alpha, c, ell, epsilon = 0.5, p = 0.5)
```

Arguments

n	Number of observations.
alpha	Parameter in $[0,2)$.
c	Parameter >0 .
ell	Tempering parameter >0 .
epsilon	Tuning parameter in $(0,1)$. Only for $\alpha \geq 1$.
p	Tuning parameter in $(0,1)$. Only for $\alpha \geq 1$.

Details

Simulates a fully right skewed CTS distribution. The distribution has Laplace transform

$$L(z) = \exp\left(c \int_0^\infty (e^{-xz}-1)e^{-x/\ell} x^{-1-\alpha} dx\right), z>0$$

and Levy measure

$$M(dx) = c e^{-x/\ell} x^{-1-\alpha} 1_{(x>0)} dx.$$

Value

Returns a vector of n random numbers.

Author(s)

Michael Grabchak and Lijuan Cao

References

M. Grabchak (2016). Tempered Stable Distributions: Stochastic Models for Multiscale Processes. Springer, Cham.

M. Grabchak (2026). Exact Simulation from Tempered Stable Distributions with Infinite Variation ($\alpha \geq 1$). <doi 10.48550/arXiv.2604.17732>.

Examples

```
rCTSP(20, 1.5, 1, 1)
```

rDickman

Simulation from the generalized Dickman distribution

Description

Simulates from the generalized Dickman distribution using Algorithm 3.1 in Dassios, Qu, and Lim (2019).

Usage

```
rDickman(n, t, b = 1)
```

Arguments

n	Number of observations.
t	Parameter > 0.
b	Parameter > 0.

Details

Simulates from the generalized Dickman distribution by using Algorithm 3.1 in Dassios, Qu, and Lim (2019). This distribution has Laplace transform

$$L(z) = \exp\left(t \int_0^b (e^{-xz} - 1) x^{-1} dx\right), z > 0$$

and Levy measure

$$M(dx) = t x^{-1} 1(0 < x < b) dx.$$

When $b=1$ and $t=1$, this is the Dickman distribution.

Value

Returns a vector of n random numbers.

Author(s)

Michael Grabchak and Lijuan Cao

References

A. Dassios, Y. Qu, J.W. Lim (2019). Exact simulation of generalised Vervaat perpetuities. *Journal of Applied Probability*, 56(1):57-75.

M. Penrose and A. Wade (2004). Random minimal directed spanning trees and Dickman-type distributions. *Advances in Applied Probability*, 36(3):691-714.

Examples

```
rDickman(10, 1)
```

rF1

Simulation from f_1 **Description**

Simulates from the pdf $f_1(x)$ introduced in Grabchak (2021).

Usage

`rF1(n, a, p)`

Arguments

<code>n</code>	Number of observations.
<code>a</code>	Parameter ≥ 0 .
<code>p</code>	Parameter > 1 .

Details

Uses Algorithm 1 in Grabchak (2021) to simulate from the pdf

$$f_1(x) = \exp(-x^p) * x^{(-1-a)} / K_1, \quad x > 1,$$

where K_1 is a normalizing constant. This is needed to simulate p-RDTS random variables.

Value

Returns a vector of n random numbers.

Author(s)

Michael Grabchak and Lijuan Cao

References

M. Grabchak (2021). An exact method for simulating rapidly decreasing tempered stable distributions. *Statistics and Probability Letters*, 170: Article 109015.

Examples

```
rF1(10, .7, 2.5)
```

rF2

Simulation from f_2 **Description**

Simulates from the pdf $f_2(x)$ introduced in Grabchak (2021).

Usage

```
rF2(n, a, p)
```

Arguments

n	Number of observations.
a	Parameter in $[0,1)$.
p	Parameter >1 .

Details

Uses Algorithm 2 in Grabchak (2021) to simulate from the pdf

$$f_2(x) = (\exp(-x^p) - \exp(-x))x^{(-1-a)}/K_2, 0 < x < 1$$

where K_2 is a normalizing constant. This is needed to simulate p-RDTS random variables.

Value

Returns a vector of n random numbers.

Author(s)

Michael Grabchak and Lijuan Cao

References

M. Grabchak (2021). An exact method for simulating rapidly decreasing tempered stable distributions. Statistics and Probability Letters, 170: Article 109015.

Examples

```
rF2(10, .7, 2.5)
```

rGGa

*Simulates from the generalized gamma distribution***Description**

Simulates from the generalized gamma distribution.

Usage

```
rGGa(n, a, p, b)
```

Arguments

n	Number of observations.
a	Parameter >0.
p	Parameter >0.
b	Parameter >0.

Details

Simulates from the generalized gamma distribution with density

$$g(x) = \exp(-b \cdot x^p) \cdot x^{a-1} / K_3, \quad x > 0,$$

where K_3 is a normalizing constant. The methodology is explained in Section 4 of Grabchak (2021). This distribution is needed to simulate p-RDTS random variables with negative alpha values.

Value

Returns a vector of n random numbers.

Author(s)

Michael Grabchak and Lijuan Cao

References

M. Grabchak (2021). An exact method for simulating rapidly decreasing tempered stable distributions. *Statistics and Probability Letters*, 170: Article 109015.

E.W. Stacy (1962) A generalization of the gamma distribution. *Annals of Mathematical Statistics*, 33(3):1187-1192.

Examples

```
rGGa(20, .5, 2, 2)
```

rPGamma

*Simulation from p-gamma distributions.***Description**

Simulates from p-gamma distributions. These are p-RDTS distributions with $\alpha=0$.

Usage

```
rPGamma(n, t, mu, p, step = 1)
```

Arguments

n	Number of observations.
t	Parameter >0 .
mu	Parameter >0 .
p	Parameter >1 .
step	Tuning parameter. The larger the step, the slower the rejection sampling, but the fewer the number of terms. See Hoefert (2011) or Section 4 in Grabchak (2019).

Details

Uses Theorem 1 in Grabchak (2021) to simulate from a p-Gamma distribution. This distribution has Laplace transform

$$L(z) = \exp\left(t \int_0^\infty (e^{-xz}-1)e^{-(\mu*x)^p} x^{(-1)} dx\right), z>0$$

and Levy measure

$$M(dx) = t e^{-(\mu*x)^p} x^{(-1)} 1(x>0)dx.$$

Value

Returns a vector of n random numbers.

Author(s)

Michael Grabchak and Lijuan Cao

References

- M. Grabchak (2019). Rejection sampling for tempered Levy processes. *Statistics and Computing*, 29(3):549-558
- M. Grabchak (2021). An exact method for simulating rapidly decreasing tempered stable distributions. *Statistics and Probability Letters*, 170: Article 109015.
- M. Hofert (2011). Sampling exponentially tilted stable distributions. *ACM Transactions on Modeling and Computer Simulation*, 22(1), 3.

Examples

```
rPGamma(20, 2, 2, 2)
```

rPRDTS	<i>Simulation from p-RDTS distributions.</i>
--------	--

Description

Simulates from p-rapidly decreasing tempered stable (p-RDTS) distributions.

Usage

```
rPRDTS(n, t, mu, alpha, p, step = 1)
```

Arguments

n	Number of observations.
t	Parameter >0.
mu	Parameter >0.
alpha	Parameter in $(-\infty, 1)$
p	Parameter >1 if $0 \leq \alpha < 1$, >0 if $\alpha < 0$.
step	Tuning parameter. The larger the step, the slower the rejection sampling, but the fewer the number of terms. See Hoefert (2011) or Section 4 in Grabchak (2019).

Details

Simulates from a p-RDTS distribution. When $\alpha \geq 0$, uses Theorem 1 in Grabchak (2021) and when $\alpha < 0$ uses the method in Section 4 of Grabchak (2021). This distribution has Laplace transform

$$L(z) = \exp\left(t \int_0^\infty (e^{-xz} - 1) e^{-(\mu x)^p} x^{(-1-\alpha)} dx\right), z > 0$$

and Levy measure

$$M(dx) = t e^{-(\mu x)^p} x^{(-1-\alpha)} 1_{(x>0)} dx.$$

Value

Returns a vector of n random numbers.

Author(s)

Michael Grabchak and Lijuan Cao

References

- M. Grabchak (2019). Rejection sampling for tempered Levy processes. *Statistics and Computing*, 29(3):549-558
- M. Grabchak (2021). An exact method for simulating rapidly decreasing tempered stable distributions. *Statistics and Probability Letters*, 170: Article 109015.
- M. Hofert (2011). Sampling exponentially tilted stable distributions. *ACM Transactions on Modeling and Computer Simulation*, 22(1), 3.

Examples

```
rPRDTS(20, 2, 1, .7, 2)
rPRDTS(20, 2, 1, 0, 2)
rPRDTS(20, 2, 1, -.7, 2)
```

rSubCTS

Simulation of CTS Subordinators

Description

Simulates from fully right skewed classical tempered stable (CTS) distributions with $\alpha < 1$. When $\alpha = 0$ this is the gamma distribution.

Usage

```
rSubCTS(n, alpha, c, ell, method = NULL)
```

Arguments

n	Number of observations.
alpha	Parameter in $[0, 1)$.
c	Parameter > 0
ell	Tempering parameter > 0
method	Parameter used by <code>retstable</code> in the <code>copula</code> package. When <code>NULL</code> <code>retstable</code> selects the best method.

Details

Simulates a CTS subordinator. The distribution has Laplace transform

$$L(z) = \exp\left(c \int_0^\infty (e^{-xz} - 1)e^{-x/\ell} x^{-(1-\alpha)} dx\right), z > 0$$

and Levy measure

$$M(dx) = c e^{-x/\ell} x^{-(1-\alpha)} 1_{(x>0)} dx.$$

Value

Returns a vector of n random numbers.

Note

Uses the method retstable in the copula package.

Author(s)

Michael Grabchak and Lijuan Cao

References

M. Grabchak (2016). Tempered Stable Distributions: Stochastic Models for Multiscale Processes. Springer, Cham.

Examples

```
rSubCTS(20, .7, 1, 1)
```

rTrunGamma	<i>Simulation from the truncated gamma distribution</i>
------------	---

Description

Simulates from the truncated gamma distribution.

Usage

```
rTrunGamma(n, t, mu, b = 1, step = 1)
```

Arguments

n	Number of observations.
t	Parameter > 0.
mu	Parameter > 0.
b	Parameter > 0.
step	Tuning parameter. The larger the step, the slower the rejection sampling, but the fewer the number of terms. See Hoefert (2011) or Section 4 in Grabchak (2019).

Details

Simulates from the truncated gamma distribution. This distribution has Laplace transform

$$L(z) = \exp\left(t \int_0^b (e^{-xz} - 1) x^{(-1)} e^{(-\mu x)} dx\right), z > 0$$

and Levy measure

$$M(dx) = t x^{(-1)} e^{(-\mu x)} 1(0 < x < b) dx.$$

The simulation is performed by applying rejection sampling (Algorithm 4.4 in Dassios, Qu, Lim (2020)) to the generalized Dickman distribution. We simulate from the latter using Algorithm 3.1 in Dassios, Qu, Lim (2019).

Value

Returns a vector of n random numbers.

Author(s)

Michael Grabchak and Lijuan Cao

References

- A. Dassios, Y. Qu, J.W. Lim (2019). Exact simulation of generalised Vervaat perpetuities. *Journal of Applied Probability*, 56(1):57-75.
- A. Dassios, Y. Qu, J.W. Lim (2020). Exact simulation of a truncated Levy subordinator. *ACM Transactions on Modeling and Computer Simulation*, 30(10), 17.
- M. Grabchak (2019). Rejection sampling for tempered Levy processes. *Statistics and Computing*, 29(3):549-558
- M. Hofert (2011). Sampling exponentially tilted stable distributions. *ACM Transactions on Modeling and Computer Simulation*, 22(1), 3.

Examples

```
rTrunGamma(10, 2, 1)
```

rTrunS

Simulation from the truncated stable distribution

Description

Simulates from the truncated stable distribution.

Usage

```
rTrunS(n, t, alpha, b = 1, step = 1)
```

Arguments

- | | |
|-------|---|
| n | Number of observations. |
| t | Parameter > 0. |
| alpha | Parameter in the open interval (0,1). |
| b | Parameter > 0. |
| step | Tuning parameter. The larger the step, the slower the rejection sampling, but the fewer the number of terms. See Hofert (2011) or Section 4 in Grabchak (2019). |

Details

Simulates from the truncated stable distribution using Algorithm 4.3 in Dassios, Qu, and Lim (2020). This distribution has Laplace transform

$$L(z) = \exp\left(t * \left(\frac{\alpha}{\Gamma(1-\alpha)}\right) * \int_0^b (e^{-xz}-1) x^{(-1-\alpha)} dx\right), z>0$$

and Levy measure

$$M(dx) = t * \left(\frac{\alpha}{\Gamma(1-\alpha)}\right) * x^{(-1-\alpha)} 1(0<x<b) dx.$$

Here $\Gamma(\cdot)$ is the gamma function.

Value

Returns a vector of n random numbers.

Author(s)

Michael Grabchak and Lijuan Cao

References

A. Dassios, Y. Qu, J.W. Lim (2020). Exact simulation of a truncated Levy subordinator. *ACM Transactions on Modeling and Computer Simulation*, 30(10), 17.

M. Grabchak (2019). Rejection sampling for tempered Levy processes. *Statistics and Computing*, 29(3):549-558

M. Hofert (2011). Sampling exponentially tilted stable distributions. *ACM Transactions on Modeling and Computer Simulation*, 22(1), 3.

Examples

```
rTrunS(10, 2, .6)
```

rTrunTS

Simulation from the truncated tempered stable distribution.

Description

Simulates from the truncated tempered stable distribution.

Usage

```
rTrunTS(n, t, mu, alpha, b = 1, step = 1)
```

Arguments

n	Number of observations.
t	Parameter > 0.
mu	Parameter > 0.
alpha	Parameter in the open interval (0,1).
b	Parameter > 0.
step	Tuning parameter. The larger the step, the slower the rejection sampling, but the fewer the number of terms. See Hoefert (2011) or Section 4 in Grabchak (2019).

Details

Simulates from the truncated stable distribution using Algorithm 4.3 in Dassios, Qu, and Lim (2020). This distribution has Laplace transform

$$L(z) = \exp\left(t * \left(\frac{\alpha}{\Gamma(1-\alpha)}\right) * \int_0^b (e^{-xz}-1) x^{(-1-\alpha)} e^{(-\mu x)} dx\right), z \geq 0$$

and Levy measure

$$M(dx) = t * \left(\frac{\alpha}{\Gamma(1-\alpha)}\right) * x^{(-1-\alpha)} e^{(-\mu x)} 1_{(0 < x < b)} dx.$$

Here $\Gamma()$ is the gamma function.

Value

Returns a vector of n random numbers.

Author(s)

Michael Grabchak and Lijuan Cao

References

- A. Dassios, Y. Qu, J.W. Lim (2020). Exact simulation of a truncated Levy subordinator. *ACM Transactions on Modeling and Computer Simulation*, 30(10), 17.
- M. Grabchak (2019). Rejection sampling for tempered Levy processes. *Statistics and Computing*, 29(3):549-558
- M. Hofert (2011). Sampling exponentially tilted stable distributions. *ACM Transactions on Modeling and Computer Simulation*, 22(1), 3.

Examples

```
rTrunTS(10, 2, 2, .6)
```

simCondS*Simulation from a conditioned stable distribution.*

Description

Implements Algorithm 4.2 in Dassios, Qu, and Lim (2020) to simulate from a stable distribution conditioned on an appropriate event.

Usage

```
simCondS(t, alpha)
```

Arguments

t	Parameter > 0 .
alpha	Parameter in the open interval $(0,1)$.

Details

Implements Algorithm 4.2 in Dassios, Qu, and Lim (2020) to simulate from a stable distribution conditioned on an appropriate event. There are some typos in this algorithm, which are corrected in Grabchak (2021). These random variables are needed to simulate truncated stable, truncated tempered stable, and p-RDTS random variables.

Value

Returns one random number.

Author(s)

Michael Grabchak and Lijuan Cao

References

A. Dassios, Y. Qu, J.W. Lim (2020). Exact simulation of a truncated Levy subordinator. *ACM Transactions on Modeling and Computer Simulation*, 30(10), 17.

M. Grabchak (2021). An exact method for simulating rapidly decreasing tempered stable distributions. *Statistics and Probability Letters*, 170: Article 109015.

Examples

```
simCondS(2, .7)
```

`simTandW`*Simulation of hitting time and overshoot.*

Description

Simulates the hitting time T and the overshoot W of a stable process by implimenting Algorithm 4.1 in Dassios, Qu, and Lim (2020). This is important for simulating other distribution.

Usage

```
simTandW(alpha)
```

Arguments

`alpha` Parameter in the open interval $(0,1)$.

Value

Returns one pair of random numbers. The first is T and the second is W .

Author(s)

Michael Grabchak and Lijuan Cao

References

A. Dassios, Y. Qu, J.W. Lim (2020). Exact simulation of a truncated Levy subordinator. ACM Transactions on Modeling and Computer Simulation, 30(10), 17.

Examples

```
simTandW(.6)
```

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