Package ‘NORMT3’

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Title Evaluates complex erf, erfc, Faddeeva, and density of sum of Gaussian and Student's t

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Depends R (>= 2.0)

Description Evaluates the probability density function of the sum of the Gaussian and Student's t density on 3 degrees of freedom. Evaluates the p.d.f. of the sphered Student's t density function. Also evaluates the erf, and erfc functions on complex-valued arguments. Thanks to Krishna Myneni the function is calculates the Faddeeva function also!

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R topics documented:

`dnormt3` *Density function of sum of Gaussian and Student's t on 3 df*

Description

Computes the probability density function of the sum of the Gaussian distribution and the Student's t distribution on 3 degrees of freedom.

Usage

```
dnormt3(x, mean = 0, sd = 1)
```

Arguments

`x`	Where to evaluate the density function
`mean`	The mean of the Gaussian
`sd`	The standard deviation of the Gaussian

Details

Computes the probability density function of the sum of the Gaussian distribution and the Student's t distribution on 3 degrees of freedom.

Value

The appropriate pdf value.

Author(s)

Guy Nason

References

Nason, G.P. (2005) On the sum of the Gaussian and Student's t random variables. *Technical Report*, 05:01, Statistics Group, Department of Mathematics, University of Bristol.

See Also

`normt3ip`,`dst`,`dnorm`

Examples

```
dnormt3(0)
#
# Should be 0.4501582 = sqrt(2)/pi
#
x <- seq(from=-5, to=5, length=100)
plot(x, dnormt3(x), type="l") # Density plot
```

dst *Density function of sphered Student's t distribution*

Description

Evaluates probability density function of sphered Student's t distribution on nu degrees of freedom. This is just the standard Student's t distribution rescaled to have unit variance.

Usage

```
dst(x, nu = 3)
```

Arguments

x	Where to evaluate the density
nu	The degrees of freedom

Details

Description says it all.

Value

The appropriate probability density.

Author(s)

Guy Nason

References

Nason, G.P. (2001) Robust projection indices. *Journal of the Royal Statistical Society*, Series B, **63**, 551–567.

See Also

dnorm, dnormt3

Examples

```
dst(0)
#
# Should be  2/pi = 0.6366198
#
x <- seq(from=-5, to=5, length=100)
plot(x, dst(x), type="l") # Produces a density plot
```

`erf` *Error function*

Description

Computes the error function of a (possibly) complex valued argument. This function is 1-erfc(z).

Usage

```
erf(z)
```

Arguments

`z`	Argument of error function

Details

Computes the error function of a (possibly) complex valued argument by computing the complementary error function and subtracting the answer from 1.

Value

The error function of z

Author(s)

Guy P. Nason, Department of Mathematics, University of Bristol

References

Poppe, G.P.M. and Wijers, C.M.J. (1990) More efficient computation of the complex error function. *ACM Transactions on Mathematical Software*, **16**, 38–46.

See Also

`erfc`

Examples

```
erf(0)
#
# Should give 0
#
erf(1)
#
# Should give 0.8427008+0i
#
erf(complex(re=1, im=1))
#
```

```
# Should give 1.316151+0.1904535i
#
```

erfc *Complementary error function*

Description

Computes the complementary error function of a (possibly) complex valued argument. This function is

$$2/\sqrt{\pi}\int_z^\infty \exp^{-t^2}\,dt$$

.

Usage

```
erfc(z)
```

Arguments

z	Argument of complementary error function

Details

Computes the complementary error function of a (possibly) complex valued argument. This function is

$$2/\sqrt{\pi}\int_z^\infty \exp^{-t^2}\,dt$$

This function actually calls FORTRAN code (algorithm TOMS 680) which computes the Faddeeva's function and then with a slight modification obtains the erfc function of a complex-valued argument.

Value

The complementary error function of z

Author(s)

Guy P. Nason, Department of Mathematics, University of Bristol

References

Poppe, G.P.M. and Wijers, C.M.J. (1990) More efficient computation of the complex error function. *ACM Transactions on Mathematical Software*, **16**, 38–46.

See Also

erf

Examples

```
erfc(0)
#
# Should give 1
#
erfc(1)
#
# Should give 0.1572992+0i
#
erfc(complex(re=1, im=1))
#
# Should give -0.3161513-0.1904535i
#
```

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ic1 *Compute IC1 formula from Nason (2005)*

Description

Computes

$$I_{C1}(p,d) = \int_d^\infty \cos(px)\exp(-x^2)dx$$

Usage

```
ic1(p, d)
```

Arguments

p	Argument for IC1 function
d	Argument for IC1 function

Details

An intermediate function for the computation of the inner product between Gaussian and Student's t distribution.

Value

Value of the function IC1

Author(s)

Guy Nason

References

Nason, G.P. (2005) On the sum of the Gaussian and Student's t random variables. *Technical Report*, 05:01, Statistics Group, Department of Mathematics, University of Bristol.

See Also

normt3ip

Examples

```
ic1(1,1)
#
# Should give 0.03401986.
#
```

---

is1 *Compute IS1 formula from Nason (2005)*

Description

Computes

$$I_{S1}(p,d) = \int_d^\infty \cos(px)\exp(-x^2)dx$$

Usage

```
is1(p, d)
```

Arguments

p	Argument for IS1 function
d	Argument for IS1 function

Details

An intermediate function for the computation of the inner product between Gaussian and Student's t distribution.

Value

Value of the function IS1

Author(s)

Guy Nason

References

Nason, G.P. (2005) On the sum of the Gaussian and Student's t random variables. *Technical Report*, 05:01, Statistics Group, Department of Mathematics, University of Bristol.

See Also

normt3ip

Examples

```
is1(1,1)
#
# Should give 0.1297382.
#
```

---

normt3ip — *Compute inner product function of Gaussian and t3 distribution*

Description

This function evaluates the inner product function of the (sphered) Student's t distribution on 3 df and the Gaussian distribution as defined by Theorem~1 of Nason, 2005

Usage

```
normt3ip(mu, sigma)
```

Arguments

mu	Mean of the Gaussian
sigma	Standard deviation of the Gaussian

Details

No extra details

Value

The evaluated function.

Author(s)

Guy Nason

References

Nason, G.P. (2005) On the sum of the Gaussian and Student's t random variables. *Technical Report*, 05:01, Statistics Group, Department of Mathematics, University of Bristol.

Examples

```
#normt3ip(0,1)
#
# Answer should be 0.3183099 which is 1/pi
#
x <- 3
```

`wofz` *Faddeeva function*

Description

Computes the Faddeeva function of a complex valued argument. This function is

$$\exp -z^2 * erfc(-iz)$$

.

Usage

```
wofz(z)
```

Arguments

`z`	Argument of Faddeeva function

Details

Computes the Faddeeva function of a complex valued argument. This function is

$$\exp -z^2 * erfc(-iz)$$

This function calls FORTRAN code (algorithm TOMS 680) which computes the Faddeeva function.

Value

The Faddeeva function, w(z)

Author(s)

Krishna Myneni, krishna.myneni@ccreweb.org

References

Poppe, G.P.M. and Wijers, C.M.J. (1990) More efficient computation of the complex error function. *ACM Transactions on Mathematical Software*, **16**, 38–46.

See Also

erf erfc

Examples

```
options(digits=15)
wofz(0)
#
# Should give 1+0i
#
wofz(1)
#
# Should give 0.367879441171442+0.607157705841394i
#
wofz(complex(re=1, im=1))
#
# Should give 0.304744205256913+0.208218938202832i
#
```

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