Package ‘dcurver’

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Title Utility Functions for Davidian Curves
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Description A Davidian curve defines a seminonparametric density, whose shape and flexibility can be tuned by easy to estimate parameters. Since a special case of a Davidian curve is the standard normal density, Davidian curves can be used for relaxing normality assumption in statistical applications (Zhang & Davidian, 2001) <doi:10.1111/j.0006-341X.2001.00795.x>. This package provides the density function, the gradient of the loglikelihood and a random generator for Davidian curves.
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dc_grad

**Description**

Provides the gradient for use in estimation.

**Usage**

```
dc_grad(x, phi)
```

**Arguments**

- `x`: A vector of observations.
- `phi`: The Davidian curve parameters. A maximum of 10 parameters is allowed.

**Details**

Woods & Lin (2009) provide the gradient (Equations 17 and 18). Note that the gradient is not defined for phi = 0.0.

**References**


**Examples**

```r
# The loglikelihood of a univariate Davidian curve is given by,
dc_ll <- function(phi, dat) {
  sum(log(ddc(dat, phi)))
}

# dc_grad can be used for obtaining the gradient of this loglikelihood as follows:
dc_LL_GR <- function(phi, dat) {
  colSums(dc_grad(dat, phi))
}

# This can be verified by numerical approximation.
# For instance, using numDeriv package:
## Not run:
phi <- c(-5, 2.5, 10)
d <- runif(10, -5, 5)
dc_LL_GR(phi, d)
numDeriv::grad(dc_ll, x = phi, dat = d)

phi <- c(-5, 0, 10)
dc_LL_GR(phi, d)
```
**ddc**

Density function for univariate Davidian curves

**Description**

Returns the density for a vector of `x`.

**Usage**

```r
ddc(x, phi)
```

**Arguments**

- `x`: vector of quantiles.
- `phi`: Davidian curve parameters. A maximum of 10 parameters is allowed.

**Examples**

```r
curve(ddc(x, 1.570789), -6, 6) # Approximately normal.
phi <- c(77.32, 78.51, 76.33, 77.16)
curve(ddc(x, phi), -6, 6) # A bimodal density.
integrate(ddc, phi = phi, lower = -Inf, upper = Inf) # Integrates to 1.
```

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**rdc**

Random samples from univariate Davidian curves

**Description**

Returns `n` samples from a univariate Davidian curve.

**Usage**

```r
rdc(n, phi)
```

**Arguments**

- `n`: Number of observations to be sampled.
- `phi`: Davidian curve parameters. A maximum of 10 parameters is allowed.
Examples

# Sample from the standard normal Davidian curve:
hist(rdc(1000, 1.570789), xlim = c(-6, 6), ylim = c(0, 0.5), freq = FALSE, breaks = 20)
curve(dnorm(x), -6, 6, col = "blue", lwd = 1, add = TRUE)
curve(ddc(x, 1.570789), -6, 6, col = "red", lwd = 2, lty = 3, add = TRUE)

# Sample from a bimodal density:
phi <- c(77.32, 78.51, 76.33, 77.16)
hist(rdc(1000, phi), xlim = c(-6, 6), ylim = c(0, 0.4), freq = FALSE, breaks = "fd")
curve(ddc(x, phi), -6, 6, col = "red", lwd = 2, lty = 3, add = TRUE)
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