Package ‘AdapSamp’

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Title    Adaptive Sampling Algorithms
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Description For distributions whose probability density functions are log-concave, the adaptive rejection sampling algorithm can be used to build envelope functions for sampling. For others, we can use the modified adaptive rejection sampling algorithm, the concave-convex adaptive rejection sampling algorithm and the adaptive slice sampling algorithm. So we designed an R package mainly including 4 functions: rARS(), rMARS(), rCCARS() and rASS(). These functions can realize sampling based on the algorithms above.
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Description

rARS generates a sequence of random numbers using the adaptive rejection sampling algorithm.

Usage

rARS(n, formula, min = -Inf, max = Inf, sp)

Arguments

n Desired sample size;
formula Kernal of the target density;
min, max Domain including positive and negative infinity of the target distribution;
sp Supporting set.

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Examples

# Example 1: Standard normal distribution
x1 <- rARS(100, "exp(-x^2/2)", -Inf, Inf, c(-2, 2))

# Example 2: Truncated normal distribution
x2 <- rARS(100, "exp(-x^2/2)", -2.1, 2.1, c(-2, 2))

# Example 3: Normal distribution with mean=2 and sd=2
x3 <- rARS(100, "exp(-(x-2)^2/(2*4))", -Inf, Inf, c(-3, 3))

# Example 4: Exponential distribution with rate=3
x4 <- rARS(100, "exp(-3*x)", 0, Inf, c(2, 3, 100))

# Example 5: Beta distribution with alpha=3 and beta=4
x5 <- rARS(100, "x^3*(1-x)^4", 0, 1, c(0.4, 0.6))

# Example 6: Gamma distribution with alpha=5 and lambda=2
x6 <- rARS(100, "x^(5-1)*exp(-2*x)", 0, Inf, c(1, 10))

# Example 7: Student distribution with df=10
x7 <- rARS(100, "(1+x^2/10)^(-((10+1)/2))", -Inf, Inf, c(-10, 2))

# Example 8: F distribution with m=10 and n=5
x8 <- rARS(100, "x^(10/2-1)/(1+10/5*x)^(15/2)", 0, Inf, c(3, 10))
# Example 9: Cauchy distribution
x9 <- rARS(100, "1/(1+(x-1)^2)", -Inf, Inf, c(-2, 2, 10))

# Example 10: Rayleigh distribution with lambda = 1
x10 <- rARS(100, "2*x*exp(-x^2)", 0, Inf, c(0.01, 10))

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**Description**

rASS generates a sequence of random numbers by the adaptive slice sampling algorithm with stepping-out procedures.

**Usage**

```r
rASS(n, x0 = 0, formula, w = 3)
```

**Arguments**

- `n` Desired sample size;
- `x0` Initial value;
- `formula` Target density function \( p(x) \);
- `w` Length of the coverage interval.

**Author(s)**

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**References**


**Examples**

```r
# Example 1: Sampling from exponential distribution with bounded domain
x <- rASS(100, -1, "1.114283*exp(-((4-x^2)^2))", 3)
plot(density(x))
```
Description

rCCARS generates a sequence of random numbers by the concave-convex adaptive rejection sampling algorithm from target distributions with bounded domain.

Usage

\[
\text{rCCARS}(n, \text{cvformula}, \text{ccformula}, \text{min}, \text{max}, \text{sp})
\]

Arguments

- \text{cvformula}, \text{ccformula}
  - Convex and concave decompositions for \(-\ln(p(x))\) where \(p(x)\) is the kernel of target density;
- \text{min}, \text{max}
  - Domain except positive and negative infinity;
- \text{sp}
  - Supporting set

Details

Strictly speaking, the concave-convex adaptive rejection sampling algorithm can generate samples from target distributions who have bounded domains. For distributions with unbounded domain, \text{rCCARS} can also be used for sampling approximately. For example, if we want draw a sequence from \(N(0,1)\) by the concave-convex adaptive rejection sampling algorithm. We know that \(X \sim N(0,1)\) has a so small probability in two tails that we can ignore the parts at both ends. \(\Pr(X>20) = \Pr(X<-20) = 2.753624\times10^{-89}\), therefore we can get random numbers approximately from \(N(0,1)\) with the bound \([-20, 20]\). Also, you can make this bound large enough to reduce sampling error.

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References


Examples

```r
# Example 1: Generalized inverse bounded gaussian distribution with lambda=-1 and a=b=2
x <- rCCARS(100, "x+x^-1", "2+log(x)", 0.001, 100, 1)
hist(x,breaks=20,probability =TRUE); lines(density(x,bw=0.1),col="red",lwd=2,lty=2)
f <- function(x) {x^(MRI*exp(MxMx^(M1II/0NRW9WS18)}````
rMARS

**Description**

rMARS generates a sequence of random numbers using the modified adaptive rejection sampling algorithm.

**Usage**

```
rmars(n, formula, min = -Inf, max = Inf, sp, infp, m = 10^(-4))
```

**Arguments**

- `n` Desired sample size;
- `formula` Kernel of the target distribution;
- `min, max` Domain including positive and negative infinity of the target distribution;
- `sp` Supporting set;
- `infp` Inflexion set;
- `m` A parameter for judging concavity and convexity in a certain interval.

**Author(s)**

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**References**

Examples

# Example 1: Exponential distribution
x <- rmars(100, "exp(-4*x^2)"), Inf, Inf, c(-2.5, 0, 2.5), c(-2/sqrt(3), 2/sqrt(3)))
hist(x, probability=TRUE, xlim=c(-3, 3), ylim=c(0, 1), breaks=20)
lines(density(x, bw=0.05), col="blue")
f <- function(x) (exp(-4*x^2))
lines(seq(-3, 3, 0.01), f(seq(-3, 3, 0.01))/integrate(f, -3)[1], lwd=2, lty=2, col="red")

# The following examples are also available; but it may take a few minutes to run them.

# Example 2: Distribution with bounded domain
# x <- rmars(1000, "exp(-x^2*x^3)"), -3, 2, 0, 1, 1/3
# hist(x, probability=TRUE, xlim=c(-3, 2.5), ylim=c(0, 1.2), breaks=20)
# lines(density(x, bw=0.2), col="blue")
# f <- function(x) exp(-4*x^2*x^3))
# lines(seq(-3, 2, 0.01), f(seq(-3, 2, 0.01))/integrate(f, -3)[1], lwd=2, lty=2, col="red", type="l")

# Example 3: Weibull distribution with k=3 and lambda=1
# x <- rmars(100, "3*x^2*exp(-x^3)"), 10^-15, Inf, c(0.01, 1, (1/3)^{(1/3)}, m=10^-4)
# hist(x, probability=TRUE, breaks=20, xlim=c(0, 2))
# lines(density(x, bw=0.15), col="blue")
# f <- function(x) 3*x^2*exp(-x^3)
# lines(seq(0, 2, 0.01), f(seq(0, 2, 0.01))/integrate(f, 0)[1], lwd=2, lty=2, col="red", type="l")

# Example 4: Mixed normal distribution with p=0.3, m1=2, m2=8, sigma1=1, sigma2=2
# x <- rmars(100, "0.3/sqrt(2*pi)*exp((-x-2)^2/2) + (1-0.3)/sqrt(2*pi)/2*exp((-x-8)^2/8)"), Inf, Inf,
# c(-6, -4, 0, 3, 6, 15), c(-5.128081, -3.357761, 3.357761, 5.128081, m=10^-8)
# hist(x, breaks=20, probability=TRUE); lines(density(x, bw=0.45), col="blue", lwd=2)
# f <- function(x) 0.3/sqrt(2*pi)*exp((-x-2)^2/2) + (1-0.3)/sqrt(2*pi)/2*exp((-x-8)^2/8)
# lines(seq(0, 14, 0.01), f(seq(0, 14, 0.01)), lty=3, col="red", lwd=2)
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