Package ‘tmg’

February 20, 2015

Type Package

Title Truncated Multivariate Gaussian Sampling

Version 0.3

Date 2015-02-11

Author Ari Pakman

Maintainer Ari Pakman <ari@stat.columbia.edu>

Description Random number generation of truncated multivariate Gaussian distributions using Hamiltonian Monte Carlo. The truncation is defined using linear and/or quadratic polynomials.

License GPL-2

Imports Rcpp

LinkingTo Rcpp, RcppEigen

URL http://arxiv.org/abs/1208.4118

NeedsCompilation yes

Repository CRAN

Date/Publication 2015-02-11 20:57:16

R topics documented:

`rtmg` *Sample from truncated multivariate Gaussians*

Description

This function generates samples from a Markov chain whose equilibrium distribution is a d-dimensional multivariate Gaussian truncated by linear and quadratic inequalities. The probability log density is

log p(X) = - 0.5 X^T M X + r^T X + const

in terms of a precision matrix M and a vector r. The constraints are imposed as explained below. The Markov chain is built using the Hamiltonian Monte Carlo technique. See the reference below for an explanation of the method.

Usage

```
rtmg(n, M, r, initial, f = NULL, g = NULL, q = NULL, burn.in = 30)
```

Arguments

- `n` Number of samples.
- `M` A d-by-d precision matrix of the multivariate Gaussian density.
- `r` A d-dimensional vector for the linear coefficient of the log density.
- `initial` A d-dimensional vector with the initial value of the Markov chain. Must satisfy the truncation inequalities strictly.
- `f` An m-by-d matrix, where m is the number of linear constraints. The constraints require each component of the m-dimensional vector

  fX + g

  to be non-negative.
- `g` An m-dimensional vector with the constant terms in the above linear constraints.
- `q` A list of quadratic constraints. Each element i of q is a 3-element list of the form

  q[[i]] = list(A,B,C)

  and imposes a quadratic constraint of the form

  X^T A X + B^T X + C >=0

  where A is a d-by-d matrix, B is a d-dimensional vector and C is a number.
- `burn.in` The number of burn-in iterations. The Markov chain is sampled n + burn.in times, and the last n samples are returned.

Details

For linear constraints, both f and g must be provided. If no values for f, g and q are provided, the function returns samples from an untruncated Gaussian. When the truncation equations define several disconnected regions, the samples belong to the region of the initial value.

Value

An n-by-d matrix, where each row contains a sample.

Author(s)

Ari Pakman

Maintainer: Ari Pakman <ari@stat.columbia.edu>

References

Pakman, A. and Paninski, L., Exact Hamiltonian Monte Carlo for Truncated Multivariate Gaussians - Journal of Computational and Graphical Statistics, 2014

http://arxiv.org/abs/1208.4118

Examples

```
# Set number of samples
n=15000;

#Define precision matrix and linear term
M = matrix(c(.5,-.4, -.4,.5), 2,2)
r = c(0,0)

# Set initial point for the Markov chain
initial = c(4,1)

# Define two linear constraints
f = diag(2)
f[1,2] = 1
g = c(0,0)

# Define two quadratic constraints
A1 = matrix(c(-1/8,0,0,-1/2),2,2)
B1 = c(.5,.5)
C1 = 3/4
constr1 = list(A1,B1,C1)

A2 = matrix(c(4,-1,-1,8),2,2)
B2 = c(0,5)
C2 = -1
constr2 = list(A2,B2,C2)

q = list(constr1,constr2)

# Sample and plot
samples = rtmg(n, M, r, initial, f,g, q);
plot(samples, pch=".")
```

Index