Homework 4

DATA604 Simulation and Modeling

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March 22, 2016

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In this problem, you will implement and investigate a series of variance reduction procedures for Monte Carlo method by estimating the expected value of a cost function c(x) which depends on a D-dimensional random variable x.

The cost function is:

$$c(x) = \frac{1}{(2\pi)^{\frac{D}{2}}} e^{-1/2x^T x}$$

where

$$x_i \sim U(-5, 5) for i = 1..D$$

Goal: estimate E[c(x)] - the expected value of c(x) - using Monte Carlo methods and see how it compares to the real value, which you are able to find by hand.

```
# First define the cost function as an R function
costFx <- function(x)
{
  b <- exp(-0.5 * t(x) * x)
  D <- length(x)
  res <- (1 / ((2 * pi)^(D/2))) * b
  return (res)
}
```

a) Crude Monte Carlo

```
crudeMC <- function(n, min, max, d = 1)
{
  # Need a loop in here
  x <- runif(d, min, max)
  gXbar <- (1/n) * costFx(x)
  theta.hat <- (max-min) * gXbar

  return (theta.hat)
}


crudeMC(1000, -5, 5)
```

```
##              [,1]
## [1,] 1.516383e-07
```