ZV-CV

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An example:

We plan to evaluate , where (a truncated normal distribution), .

Suppose , , , ,.

We can obtain expectation analytically by:

library(ZVCV)  
library(truncnorm)  
  
true\_value =function(smin,smax,mu,sigma,t){  
 a = (smin - mu)/sigma/sqrt(2\*t)  
 b = (smax - mu)/sigma/sqrt(2\*t)  
 mean\_value = etruncnorm(a,b,mean=0,sd =1/sqrt(2\*t))  
 var\_value = vtruncnorm(a,b,mean=0,sd=1/sqrt(2\*t))  
 true\_value = -0.5\*log(2\*pi)-log(sigma)- mean\_value^2-var\_value  
 return(true\_value)  
}  
  
  
N <- 1000  
#mymean = c(1,2)  
#mycov <- matrix(c(1,0.5,0.5,2),nrow=2)  
mymean = 1  
mycov = 1  
t = 1  
require(mvtnorm)

## Loading required package: mvtnorm

set.seed(1)  
samples <- rtruncnorm(N,a=-2,b=2,mymean,sqrt(mycov/t/t))  
# samples <- rmvnorm(N, mean = mymean, sigma = mycov)  
integrand <- dnorm(samples,mymean,sqrt(mycov/t/t),log=TRUE)  
  
  
#' # derivatives of Gaussian wrt x  
#derivatives <- t( apply(samples,1,function(x) -solve(mycov)%\*%(x - mymean)) )   
derivatives <- c(-solve(mycov))\*(samples-mymean)\*t  
#'   
#' # Estimates without ZV-CV (i.e. vanilla Monte Carlo integration)  
#' # Without the ZVCV package  
mean(integrand)

## [1] -1.29701

#' # With the ZVCV package  
order0<-zvcv(integrand,samples,derivatives,options = list(polyorder = 0))$expectation  
  
# polynomial with order 1   
order1<-zvcv(integrand,samples,derivatives,options = list(polyorder = 1,regul\_reg=FALSE))$expectation  
  
# polynomial with order 2   
order2<-zvcv(integrand,samples,derivatives,options = list(polyorder = 2,regul\_reg=FALSE))$expectation  
  
# true value  
tv <- true\_value(smin=-2,smax=2,mu=mymean,sigma=sqrt(mycov/t/t),t=1)  
  
sprintf(paste('true value:',tv))

## [1] "true value: -1.26699339309368"

sprintf(paste('order 0:', order0))

## [1] "order 0: -1.29700975804559"

sprintf(paste('order 1:', order1))

## [1] "order 1: -1.13422114758399"

sprintf(paste('order 2:', order2))

## [1] "order 2: -1.41893853320467"