ZV-CV test

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An example:

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

We can obtain expectation analytically by:

By using the fact that is a standarded truncated normal distribution with boundary points , , the packakage etruncnorm(.) and vtruncnorm(.) can be used to get the value for 2nd moments.

In the implementation:

Integrand is

samples are , where

derivates are

Set , , (coding for t is omitted), , and N=2000 (number of samples).

library(ZVCV)  
library(truncnorm)  
  
true\_value =function(smin,smax,mu,sigma,t){  
 a = (smin - mu)/sigma\*sqrt(t)  
 b = (smax - mu)/sigma\*sqrt(t)  
 mean\_value = etruncnorm(a,b,mean=0,sd=1)  
 var\_value = vtruncnorm(a,b,mean=0,sd=1)  
 true\_value = -0.5\*log(2\*pi)-log(sigma)- 0.5\*(mean\_value^2+var\_value)/t  
 return(true\_value)  
}  
  
N <- 2000  
  
mymean = 0  
mycov = 1  
  
require(mvtnorm)

## Loading required package: mvtnorm

set.seed(1)  
smin\_set = -2  
smax\_set = 2  
samples <- rtruncnorm(N,a=smin\_set,b=smax\_set,mymean,sqrt(mycov))  
  
integrand <- dnorm(samples,mymean,sqrt(mycov),log=TRUE)  
  
  
#' # derivatives of Gaussian wrt x  
derivatives <- -c(solve(mycov))\*(samples-mymean)  
#'   
  
#' # With the ZVCV package  
# order 0 is the naive MC estimate  
order0<-zvcv(integrand,samples,derivatives,options = list(polyorder = 0))$expectation  
  
# MC\_est <- mean(dnorm(samples,mean = mymean,sd = sqrt(mycov), log=TRUE))  
# 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=smin\_set,smax=smax\_set,mu=mymean,sigma=sqrt(mycov/1/1),t=1)  
  
  
paste('smin/smax:',smin\_set,'/',smax\_set)

## [1] "smin/smax: -2 / 2"

paste('true value:',tv)

## [1] "true value: -1.30580918497963"

paste('order 0:', order0)

## [1] "order 0: -1.31796433114557"

paste('order 1:', order1)

## [1] "order 1: -1.31783810264888"

paste('order 2:', order2)

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