MA323-Monte Carlo Simulation Assignment-7

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Qus1-

The exact value of I is 2 .

(a)for m=100

value of I_m = 2.079135081051508

Difference between I and I_m=0.079135

Variance of y :0.21236100167750255

The 95 percent confidence interval for the I :(1.770729647781824 , 2.3875405143211923)

(b)for m=1000

value of I_m = 2.002145439820333

Difference between I and I_m=0.002145

Variance of y :0.19262551196703145

The 95 percent confidence interval for the I :(1.9045687531885325 , 2.0997221264521335)

© for m=10000

value of I_m = 1.99419469094522

Difference between I and I_m=0.005805

Variance of y :0.19575112712429008

The 95 percent confidence interval for the I :(1.9636311162246156 , 2.0247582656658243)

(d)m=100000

value of I_m = 1.9979772880940911
Difference between I and I_m=0.002023
Variance of y :0.19618727823338508
The 95 percent confidence interval for the I :(1.9882879670111016 , 2.0076666091770807)

OBSERVATION: Value of I_m is almost equal to the exact value of I.

Qus2-
using antithetic variates: **k=(np.exp(np.sqrt(x))+np.exp(np.sqrt(1-x)))/2**

(a) For m=100
value of I_m = 1.9952075557520905
Variance of y : 0.0015820757647553745
Old Variance of y : 0.21191991210417105
The 95 percent confidence interval for the I is
(1.698697301578235 , 2.291717809925946)
Percent of variance reduction : 99.2534558225101%

(b) for m=1000
value of I_m = 2.001614639955897
Variance of y : 0.0009217842548573342
Old Variance of y : 0.1865127443694157
The 95 percent confidence interval for the I is
(1.909250024099212 , 2.0939792558125823)
Percent of variance reduction : 99.5057794801241%

©for m=10000
value of I_m = 2.0004910711842983
Variance of y : 0.0010196606488633657
Old Variance of y : 0.1920575131765153
The 95 percent confidence interval for the I is
(1.9710599203144699 , 2.0299222220541266)
Percent of variance reduction: 99.4690857795674%

(d) for m=100000
value of I_m = 1.9997964614522294
Variance of y : 0.00108308271081363
Old Variance of y : 0.19556893075523127
The 95 percent confidence interval for the I is
(1.9904906599664443 , 2.009102262938015)
Percent of variance reduction : 99.44618876493772%
OBSERVATION: Antithetic variable approach achieved about 99.45% reduction.

Qus3-
Using control variates - √ U :

```
mcv=np.mean(X2)                  #mean of sqrt(U)
vcv=np.var(X2)                   #var of sqrt(U)
a=covariance(X2,Y2)/vcv           # cov(X2,Y2)/vcv
k=(np.exp(np.sqrt(x)) - a*(np.sqrt(x)-mcv))          #control variante
```

(a)For m=100
value of I_m = 1.9800817056419182
The 95 percent confidence interval for the I is
(1.6757136365237328 , 2.2844497747601036)
Variance of y : 0.002833731895532407
Old Variance of y : 0.20411584962267854
Percent of variance reduction : 98.61170413724817%

(b)For m=1000
value of I_m = 2.0001693158586904
The 95 percent confidence interval for the I is
(1.9074950663351053 , 2.0928435653822755)
Variance of y : 0.002801667583691633
Old Variance of y : 0.19273678547059026
Percent of variance reduction : 98.54637630442417%

© For m=10000
value of I_m = 2.0012930959856394

The 95 percent confidence interval for the I is
(1.9717800494429947 , 2.030806142528284)
Variance of y : 0.0027301807769369055
Old Variance of y : 0.19435764090352226
Percent of variance reduction : 98.59527993638689%

(d) For m=100000
value of I_m = 1.9984792226953934
The 95 percent confidence interval for the I is
(1.9891675353582121 , 2.0077909100325746)
Variance of y : 0.002716417772714766
Old Variance of y : 0.19460269298661054
Percent of variance reduction : 98.60412118094293%

Observations: The control variate approach achieved about 98.60% reduction.

Thank you