Asian option call price

Table of Contents

Consider the following integral, which arises in the pricing of an Asian arithmetic mean call option

$$\int_{R^2} \max\left(\frac{1}{2}[S_1(z_1) + S_2(z_2)] - 100, 0\right) \exp\left\{\frac{-z^T\Sigma^{-1}z/2}{\sqrt{(2\pi)^2\det(\Sigma)}}\right\} dz$$

Notice the exponent part ($e^{g(z)}$) coresponds to the probability distribution function of a normally distributed random vector with covariance matrix Σ. That's the main reason we will generate IID standard normal random variables. We omit the mathematical justification here.

Parameters

```
abstol = 0.02;          % absolute error tolerance
reltol = 0;             % relative error tolerance
Sigma = [.5 .5; .5 1];  % covariance matrix
```

Integral approximation

Monte Carlo methods can be used to estimate expectations, the mean value of a random variable's function. For continuous variables, expectations take the form of integrals.

Therefore, if we can express an integral as an expectation, it is possible to estimate its value using Monte Carlo methods.

```
A = chol(Sigma); % Sigma = A'*A

s_1 = @(z_1)100*exp(-0.0225 + 0.3*z_1);
s_2 = @(z_2)100*exp(-0.045 + 0.3*z_2);
z = @(n)randn(n, 2)*A;

g = @(n)gsub(n, z, s_1, s_2); % encapsulate inner function

tic;
[muhat, out] = meanMC_g(g, abstol, reltol);
toc;
```

Output results

```
disp(['The estimated fair price is ' num2str(muhat)])
```

```
The estimated fair price is 9.432
```

Function

```
function [price] = gsub(n, z, s_1, s_2)
%GSUB Pricing of an Asian arithmetic mean call option
zn = z(n);
s1 = s_1(zn(:, 1));
s2 = s_2(zn(:, 2));
asianCallOpt = .5*(s1 + s2) - 100;
price = max([asianCallOpt zeros(n, 1)], [], 2);
end
```

```
Elapsed time is 0.694385 seconds.
```

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