

## Setting and theoretical value in BS formula

### ERI's Black-Scholes Calculator

#### Input Data

Stock Asset Price:	<input type="text" value="50"/>	US \$	Example: "25.00"
Option Strike Price:	<input type="text" value="55"/>	US \$	Example: "15.00"
Maturity (Time Until Expiration):	<input type="text" value="0.1"/>	Years	Example: "3.5"
Risk-Free Interest Rate:	<input type="text" value=".01"/>	Annual %	Example: ".05" (for 5%)
Volatility:	<input type="text" value=".25"/>	Annual %	Example: ".20" (for 20%)

Calculate

#### Options (Fair Value)

European Call:	<input type="text" value="0.2357"/>	US \$
European Put:	<input type="text" value="5.1808"/>	US \$

Play

## Pricing using COS method and IV expansion

Below is the result.

Really really convergent!!

We can see the implied volatility expansion is precisely equal to the COS method rapidly. The truncationOrder is now only  $\sim O(\text{numGrid})$  and has an asymptotic property.

```

*****
Hyperparameters:
S0: 50 r 0.01 q 0 sigmaBSM 0.25
*****
a and b (truncated interval):
-1.04611847785 0.851248118246
Vk:
[ 11.52014812  17.16894285   5.83296472  -0.65984476  -0.46105836
  0.96447312]
*****
calculate put option price using COS method:
numGrid: 5
5.47621280901
numGrid: 20
5.17776647905
*****
calculate put option price using IV expansion method:
numGrid: 5 truncationOrder: 5
5.47621934325
numGrid: 20 truncationOrder: 20
5.17776647902

```