REPORT 3, Option Pricing using Binomial, Black-Scholes and Leisen Models

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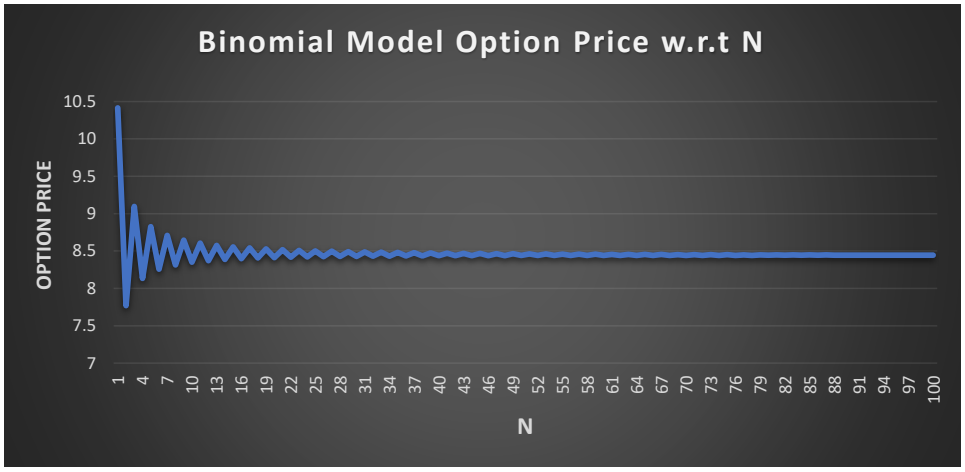
The task of option pricing requires a solid model for the stock price. In this report, we incorporate three methods to price a call option with given parameters. We start with a binomial model which considers two possible payoffs after T, the maturity time. On the other hand, Black-Scholes is a model established on geometric Brownian motion which considers a continuous time-space in maturity time. Furthermore by increasing the time steps we try to show the binomial model solution converges to the black-Scholes price. Finally, we enhance the binomial model by replacing it with Leisen model. A better convergence, therefore, is obtained in the latter case. We start by listing the pre-specified parameters:

Stock Price	S	100
Strike Price	X	100
Time period	T	1
Interes Rate	R	0.01
Volatility	SD	0.2
Number of Steps	N	1

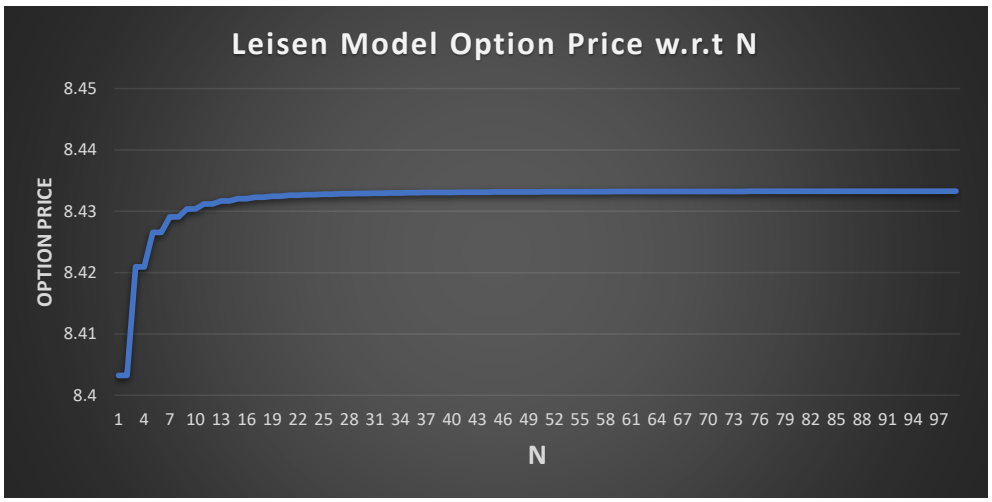
For the binomial model, we use the Function Bi_Call_Eur (S, X, T, r, sd, n As Integer), implemented in the Visual Basic module. We increase the number of n to test the convergence of the binomial model to the Black-Scholes price of the option. The option price per n can be plotted as below:



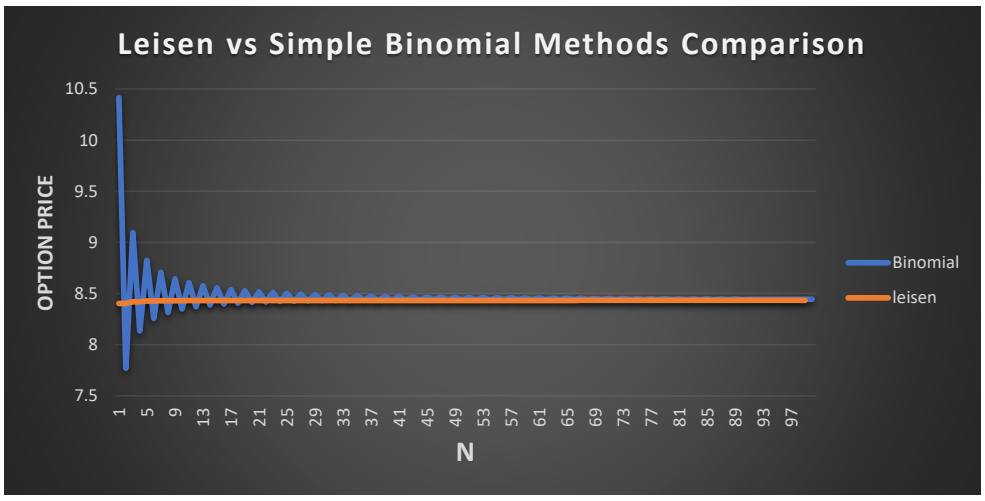
Black-Scholes model adpats brownian motion for the stock price with a constatnt volatility. This time we use Function BSCall (Stock As Double, Exercise As Double…). The value for option price we are getting out of Black-Scholes model is the one we take as a refrenece to evaluate the convergence of other two discrete models.

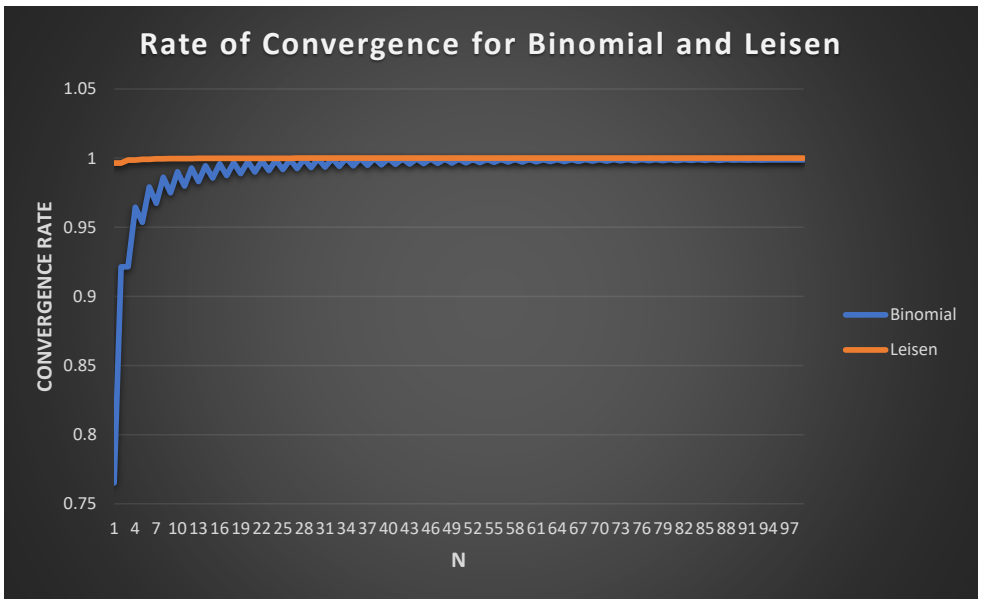
	Option Price
Black-Scholes	8.43331869

Now we use a new defined binomial model which we call the Leisen model. This model is somehow the improved version of the static binomial model. Using Leisen instead of the former binomial model leads to better convergence to the Black-Scholes solution. At the same time, smaller values for the initial error are obtained.



Now that we have the solution of Binomial and Leisen, we can plot them together to have a comparison view of the subject. We also measure the convergence rate in both cases. Convergence rate is calculated using the differnce of estimated price and the Black-Scholes solution normalized to be less than one.





As we can see, we are provided with better convergence and smaller initial error when we use Leisen binomial model instead of the normal binomial model.