Binomial Model

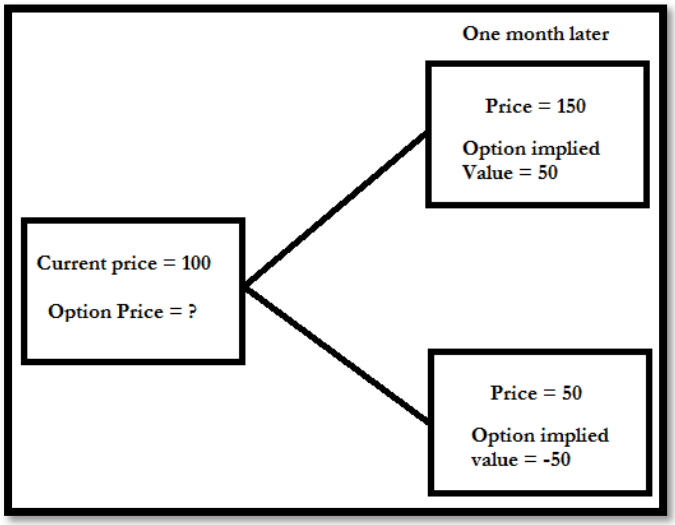
This service is auto-traded, so we do the trading for you. You don't need to learn the full details of this strategy, but for those that are curious enclosed is a case study that entails the mechanics of how calendar spreads work.

When trading options it is important to perform valuation analysis just as you would on any other asset class. Buying an option that is expensive can affect the outcome of the trade just as much as being correct about the direction and magnitude of the underlying move. An expensive option can have higher time value decay, or experience a volatility crush that could quickly put a position in the red. The two primary models used to price options are the Black Scholes model and a binomial model.

Many are familiar with the classic Black-Scholes model that uses instantaneous derivatives and inputs from the Greeks to price an option contract. Though this model is comprehensive and allows traders to control each Greek along with movement of the underlying, it is complicated and difficult to use without a computer program. Also many programs will back out the Greeks by using the current price, thus making it impossible to use it as a valuation tool. Many times a better approach to calculate the value of an option contract is to use the binomial pricing model.

The binomial model allows for a stand-alone valuation, and can be used to find the expected move of the underlying asset if used in reverse. More than just the utility of the binomial model it is far simpler to use the binomial approach than the Black-Scholes approach making it easier to use. In fact the binomial model can be easily calculated with pen and paper.

The binomial model essentially comprises two steps. The first step is to create a pricing tree that is a representation of all possible outcomes. Generally this is simplified to the underlying stock moving a set amount both up and down over one period of time, thus creating a node. The figure below shows a single node of a tree for an option of strike 100.



The movement one month later expects either a $50 appreciation or a $50 depreciation of the underlying stock. With the movement as shown we know the contract would gain or lose the respective intrinsic value. These intrinsic values are used in the next step.

The next step is to discount the expected portfolio values to present value of the contract. To simplify the model we expect that all options are exercised at expiration thus resulting in a portfolio value at either end node valued with shares and an option. Similar to a discounted cash flow model for equity this provides a valuation of what an investor should pay for a contract given the possible payouts. In the end, the contract value is shown by the following formula.

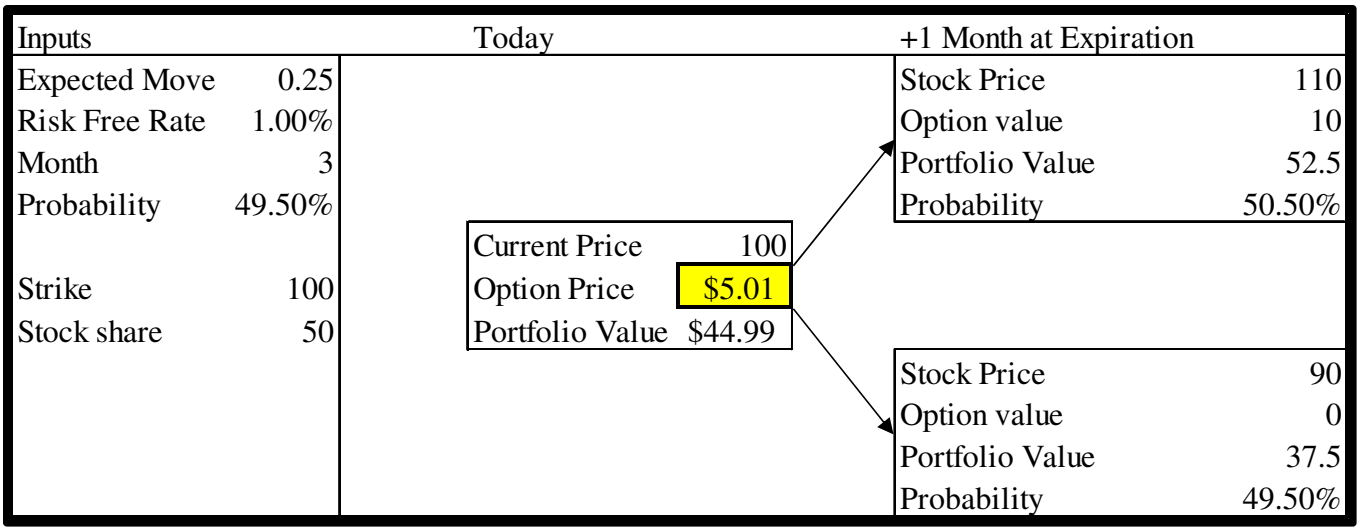
$$Value\ of\ contract\ today = (probability\ of\ going\ up * portfolio\ implied\ value + probability\ of\ going\ down * portfolio\ implied\ value) * e^{-rt}$$

Essentially this is a summation of all possible values in the following node and discounting those to current day where r is the risk free rate and t is number of periods. To use this formula we also need to calculate the probabilities of each node. This is done through geometric Brownian motion and calculated by the following formula:

$$probability = \frac{e^{(-rt)} - d}{u - d}$$

Where d is 1 – the expected move, u is 1 + the expected move, r is the risk free rate, and t is the time factor. This completes the model and will provide a value for an option contract. It is also possible to adjust the probabilities to what an investor believes to be more accurate. Doing so allows the trader to make a better informed decision about the potential trade.

Here is an example of using the binomial model to calculate the value of an option contract. In this example we analyze a 3 month option with strike of 100, a current stock price of 100, and an expected move of the stock of 25%. First we need to select a risk free rate. Generally we use US Treasury bills, but for simplicity sake we'll use a simple 1.00% rate. Second we must calculate the probability of an up and down move. This is done through the Brownian motion probability formula and gives us a value of 49.5% for the downward move. Next we need to calculate the expected portfolio value. For this we assume that a complete portfolio includes half a share and one call option. Assuming the price goes up by the expected move the shares would appreciate to 50(1+.25) = 62.5. The call option would similarly appreciate to the strike minus the current price or 10. Performing a similar procedure for the downside scenario we get 37.5. Note that in this scenario the option would have no more value since the price has dropped under the strike price. The final step is to multiply the portfolio values by their respective probabilities and return them to present value using the risk free rate. Doing this we get a final value of $5.01. Below is a breakdown of the calculations.



Another trick that the binomial model allows for is backing into the probabilities. This provides what the market is pricing in the expected underlying movement. This can be helpful to determine whether the contract is worth purchasing. If the implied move is less than what a trader thinks will actually happen then the option is much more likely to profit when it surpasses this expected movement.

At the end of the day the binomial model is another tool that makes it easier for traders to pick the right contracts to augment their performance. It is extremely beneficial to use a valuation system to improve positions, reduce cost basis, and increase probability of high profit trades.

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