Market-Consistent Valuation & Embedded Value 2012/2013
Tutorial Questions for Week III.

Unless stated otherwise, discounting is performed using exponential rates.

1. **Valuation of a Straddle**
   A Straddle is a European-style option which gives the holder the right to use this contract as either a Call or as a Put option on some underlying stock at expiry, whichever he or she likes best at that time.

   a) Find the price of a straddle with strike price 60 and 5 months until maturity, for a stock with current value 55 and a yearly volatility of 25%. Use a 5-period binomial tree, and assume that the risk free rate is 3% per year.
   b) If somebody sells 5000 straddles today, estimate how much of the underlying stock he/she will buy today to hedge the position.
   c) Show carefully that the hedge you calculated in b) will indeed make the position riskless for the next time step in the binomial model.
   d) Suppose we define an American-Style Straddle, where one may also exercise the option before maturity, either as a put or as a call. What is the price of this option ?

2. **Valuation using Deflators**
   Consider the European-style straddle of the previous question. We want to determine its value again, but this time using a deflator method. We assume that the stock price has a mean rate of return μ of 6% from which the logarithmic mean rate of return $v=\mu-\sigma^2/2$ and original probabilities $p=½+½(v/\sigma)\sqrt{\Delta t}$ for upward moves and and 1-p for downward moves can be calculated.

   a) Build a copy of the tree used in 1a), in which every nodes contains the probability of the stock price process passing through that node (under the original probabilities p). This gives the binomial distributions of the stock price process.
   b) Build a copy of the tree used in 1a) with the values of the deflator process H on it.
   c) Use the probabilities in the final column and the deflator process in the final column to check
      i) The value of the European-style straddle,
      ii) The value of a single stock, and
      iii) The value of a single bond.

3. **"As you like it" option**
   Consider the same stock and interest rate environment as the first exercise: stock with volatility 25% is now worth 55, and riskfree rate is 3% per year. Consider an 'As you like it' option: an option which has a time to maturity of 5 months and a strike price of 60, which can be declared, after exactly 3 months, to be either a European Call option or a European Put option.

a) Explain why you can immediately conclude that the price of this option must be
    I. Larger than the value of an ordinary 5 month European call with the same specifications
    II. Larger than the value of an ordinary 5 month European put with the same specifications
    III. Less than the sum of the values of an ordinary 5 month European put and call
b) Find the value of the ordinary European Put and the ordinary European Call in this case (Hint: build two copies of the same tree for this, you will need them later).
c) Show that the sum of these two ordinary European options is the same as the value of the European straddle in question 1a). Explain this.
d) Find the value of the 'As You Like It' option.

Michel Vellekoop,
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