Simple Options Valuation Program for
Lotus 123

James N. Bodurtha, Jr.
The University of Michigan
School of Business
Ann Arbor, MI  48109
U.S.A.

Version 1.2

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This program is based on the original binomial option pricing work of Cox, Ross and Rubinstein (1979), as extended by Cox and Rubinstein (1985), and Bodurtha and Courtadon (1987) for the currency option application. The set of programs are for learning purposes. These programs are under development, and license to use and/or copy them must be obtained explicitly. In either case, proper attribution must be made to the source of the program and its logic. Furthermore, possession of these valuation programs in no way confers the right to use Lotus 123. Users also must obtain the right to use Lotus 123 (Lotus Development Corp., copyright 1985) on their own. Finally, users of these programs must be aware that they are subject to error. Under no circumstances will any party involved in their development or dissemination be liable for any special, consequential or incidental damages arising from their use.
Simple Options Valuation Program for Lotus 123

This documentation provides a description of the required inputs to the programs, and instructions on how to access the file to calculate option prices. A few other points of interest are discussed. Of these points, the interest rate warning and discrete current yield sections should be reviewed.

A) Calculating Option Prices

1. Required Data

   **Spot Price:** Underlying asset current price.
   **Current Yield:** Yield paid on a position on the underlying asset matching the (may be calculated with Lotus @Date function).
   **Cost of Funds:** The cost of funds for the number of days to maturity (a zero coupon rate).
   **Option type:** 1 for a call, and -1 for a put.
   **Exercise price:** Price at which the underlying can be bought (for calls) or sold (for puts) on or through expiration (in the same units as current price).
   **Days to Maturity:** Number of days between current date and option expiration.
   **Annual volatility:** Volatility of the underlying asset price scaled to an annual (365 day) basis.

2. Insert option program disk in the floppy drive. Alternatively, copy the program from the network to a floppy disk.

3. To obtain a fresh spreadsheet, load Lotus 123.

4. Retrieve the file OPTSIMPL.WK1. The command is

   `/F[file]R[etrieve]OPTSIMPL~`

   *(The ~ symbol indicates to strike enter.)*
5. The following screen will appear.

******************************************************************************

SIMPLE OPTIONS VALUATION PROGRAM FOR LOTUS 123

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VERSION 1.2

THIS APPLICATION IS BASED ON THE ORIGINAL BINOMIAL OPTION PRICING
WORK OF COX, ROSS AND RUBINSTEIN (1979), AS EXTENDED BY COX AND
OPTION APPLICATION. USERS OF THESE LOTUS 123 SPREADSHEET PROGRAMS MUST
BE IN COMPLIANCE WITH THE TERMS OF THE PROGRAM DOCUMENTATION.

STRIKE [ENTER] TO BEGIN.

******************************************************************************

6. Strike enter.

7. The following option spreadsheet calculator appears.

SIMPLE OPTIONS VALUATION PROGRAM:

<table>
<thead>
<tr>
<th>PARAMETERS</th>
<th>INPUT</th>
<th>AMERICAN MODEL</th>
<th>EUROPEAN MODEL</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>PRICE</td>
<td>2.202</td>
<td>2.169</td>
</tr>
<tr>
<td></td>
<td>DELTA</td>
<td>0.4820</td>
<td>0.4676</td>
</tr>
<tr>
<td></td>
<td>GAMMA</td>
<td>0.0690</td>
<td>0.0641</td>
</tr>
<tr>
<td></td>
<td>THETA</td>
<td>6.2319</td>
<td>5.7206</td>
</tr>
</tbody>
</table>

CURRENT PRICE 167.7300
CURRENT YIELD (5% AS .05) 8.646%
COST OF FUNDS (10% AS .1) 6.812%
OPTION (1, CALL; -1, PUT) 1
EXERCISE PRICE 167.7300
DAYS TO MATURITY 60
ANNUAL VOLATILITY (10% AS .1) 9.00%

USE CURSOR KEYS TO GET TO HIGHLIGHTED INPUT CELLS, AND ENTER MODEL
PARAMETERS. THEN, STRIKE THE "CALC" KEY TO RUN. TO RESTART, IF YOU
 NEED TO, HOLD DOWN THE "ALT" KEY AND STRIKE S. QUIT AS USUAL.

8. The input cells are highlighted in column C, rows 151 to 157.

9. Follow directions at the bottom of the screen to calculate
10. Note: each option price should take about ten seconds to compute. A 30 step binomial approximation is used. An adjustment is made for high current yield assets, if necessary.

11. To leave Lotus directly give the command: /QY.

B) Valuing Futures Contract Options

The model will handle these option contracts with no difficulty. However, there are two changes in the required inputs. These are

1. The current futures price replaces the spot price

2. The yield on the underlying asset should be set equal to the cost of funds.

The relationship between spot prices, current yields, the cost of funds and the futures price makes this adjustment appropriate.

C) Implied an Option Volatility

An easy way to determine implied volatility is simply to note current market option input parameter and price levels, and then try different levels of volatility to match up the model price with the current market price. A useful trick is to use two specific initial guesses: one volatility too high and one too low. Then, a relatively close approximation to the actual implied volatility can be linearly interpolated from these two volatilities, the two related option values and the option value for which the implied volatility is sought. This approach will be quicker than simple iterative search schemes because the American model takes a fair amount of time to run in Lotus.

D) Interest Rate Input Warning

This model makes no adjustment of the current yield and cost of fund inputs. Such an adjustment should be made which is consistent with the conventions in the underlying instrument, e.g. 360 day bank year. The option models require that continuously compounded rates be input into the model. To make an adjustment from quoted market rates to continuously compounded rates, a formula can be entered in the cells B9 (labeled RF, the current yield) and B10 (labeled RD, the cost of funds) as appropriate. These adjustments will become of predominant importance as the option maturity is lengthened.

E) Discrete Changes in Current Yield (e.g. Stock Dividends)

The model is built under the assumption that cash paid to owners of the underlying, such as dividends and interest, are paid continuously at a
constant rate over the life of the option. This assumption is relatively
accurate for valuing puts generally, and calls on bonds, commodities,
currencies and stock index portfolios. When current yield (dividend) is not
paid daily at a roughly constant rate, the model may be off. The American
model will almost certainly misvalue stock call options when the stock is
about to pay a large dividend. In this case, the owner of an American call
option may well want to exercise their call prior to the dividend, because
they know that the stock price will fall by roughly the amount of the
dividend on the stock ex-dividend date.

To use our model to treat the case when one dividend will be paid over
the life of the option, we suggest valuing two related European options.
These European options have different expiration dates, and slightly
different inputs. The expiration date for the first European option is the
dividend record date and the expiration date for the second option is the
actual expiration date. The American option value on the dividend paying
stock can be approximated as the maximum of these option values.

The inputs for these two "European options" differ. The inputs for the
first expiration date option should be the same as those in our original
example, except that the maturity is shorter and

Current yield set to zero (no dividend is actually paid in the
period, the option holder gets full right to the share proceeds)
Cost of funds should correspond to the period to the record date, not
the option maturity

The second or true expiration date call will have inputs equivalent to those
in our original example, except that the stock price must be decreased by
the amount of the dividend. This adjustment is made to account for the fact
that holding the option to maturity means that the call owner did not own
the stock on the dividend record date and has no claim to the dividend.

The value of the American option on a dividend paying stock is then
approximated by the maximum of the value of these two European options.
This approximation was suggested by Fischer Black, and works relatively
well. The approach can also be extended to handle more than one dividend,
though the approximation is usually less satisfactory in this case.

F) Worksheet Protection

The worksheet is protected, and only the highlighted cells may be
changed. To tailor the spreadsheet to meet your needs, you will want to
disable the protection. Protection is turned off by the following command:


Protection is turned back on by the following command: