



hp calculators

HP 30b Black-Scholes Option Pricing

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Black-Scholes on the HP 30b

Practice solving problems involving
Black-Scholes Option Pricing



Black-Scholes Option Pricing

Black-Scholes is a mathematical model useful for valuing European call and put options. Options give the holder the right to buy or sell units of an underlying asset for a period of time at a specified price. A call option is the right to buy and a put option is the right to sell. Specifically, a call option gives the holder of the option the ability to buy a specified number of shares of a stock at a specified price before a certain date, regardless of the actual price of the stock on that date. A put option gives the holder of the option the ability to sell a specified number of shares of a stock at a specified price before a certain date, also regardless of the actual price of the stock on that date.




For example, assume a call option allows the purchase of 100 shares of a stock at \$40 per share six months from now. At that six month point, if the stock is worth \$50, the holder of the option can buy it for \$40 and earn \$10 per share immediately. If the stock is worth only \$38 at that six month point, the option to buy at \$40 would not be exercised, as it would lose \$2 per share.

The Black-Scholes computations assume a European option. This differs from an American option in that a European option can only be exercised at the end of its life, or at its maturity. All other things being equal, the price for an American option will usually be higher than for a European option, since the American option can be traded at any time until its expiration.

Inputs to the Black-Scholes pricing model include:

- the current stock price, called a spot price;
- the exercise or strike price;
- the time until the option maturity or expiration;
- the risk free interest rate;
- the standard deviation of the day-to-day changes in the stock's price; and
- the dividend percentage of the stock.

Black-Scholes Option Pricing on the HP 30b

The HP 30b solves Black-Scholes option problems using the Black S menu. This menu is entered by pressing  and  at the SAME TIME. Press the shift key and continue to hold it while pressing the bond key. If you do this correctly, you will see the screen shown below. The map of this menu is presented at right. To move from one item in the menu to the next, press the down arrow key . This key is abbreviated DWN in the map to the right.

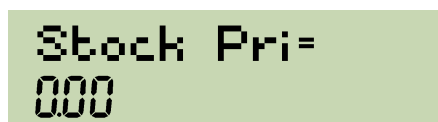
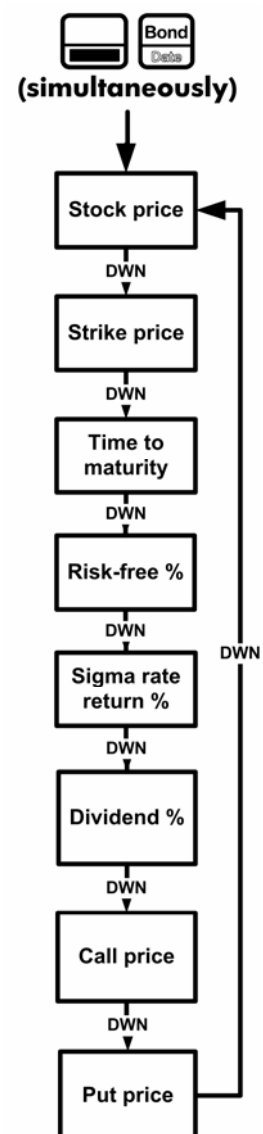




Figure 1

The menu items displayed on the HP 30b are shown in the table on the next page.



Black-Scholes Menu Items

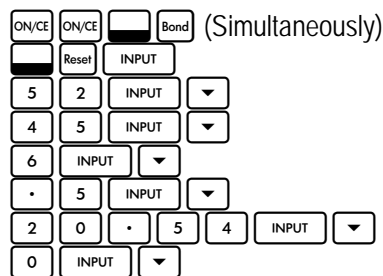
Menu Item/Key	Description
  (Simultaneously)	Opens the Black-Scholes menu starting with <i>Stock Price</i> .
<i>Stock Price</i>	The current spot price for the stock. Input only.
<i>Strike Price</i>	The strike or exercise price for the stock. Input only.
<i>Time to maturity</i>	The time until the stock option matures / expires. Input only.
<i>Risk Free%</i>	The risk free rate of return. Input only.
<i>σ Rate Return%</i>	The standard deviation of the day-to-day changes in the stock's price. Input only.
<i>Dividend%</i>	The stock dividend percent. Input only.
<i>Call Price</i>	Price of the European call option for the stock. Output only.
<i>Put Price</i>	Price of the European put option for the stock. Output only.

To clear the Black-Scholes menu while in the menu, press  .

Practice solving problems involving Black-Scholes Option Pricing

Example 1: An option has 6 months to run and a strike price of \$45. If the stock price is presently \$52 per share, what are the estimated values of a call and put option for the stock? Assume the stock's return volatility is 20.54% per month and that the risk free rate is 0.5% per month.

Solution:



Call Price =
14.22

Figure 2



Put Price =
5.89

Figure 3

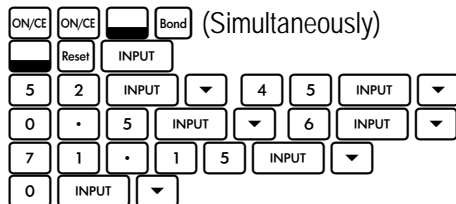
Answer: The call option is valued at \$14.22 per share and the put option at \$5.89 per share. Note that all inputs MUST use the same time frame. If 6 months is entered as a 6, all other inputs must be monthly amounts. The next example will solve this problem using annual inputs.

HP 30b Black-Scholes Option Pricing

Example 2: An option has 6 months to run and a strike price of \$45. If the stock price is presently \$52 per share, what are the estimated values of a call and put option for the stock? Assume the stock's return volatility is 20.54% per month and that the risk free rate is 0.5% per month.

Converting these to annual values generates a risk free rate of 6% per year (0.5×12), a time to maturity of 0.5 (6 divided by 12) and an annual return volatility of 71.15% ($20.54 \times \text{the square root of } 12$).

Solution:



Call Price =
14.22

Figure 4



Put Price =
5.89

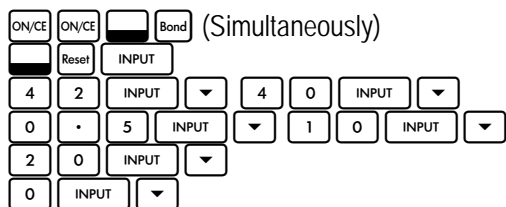
Figure 5

Answer: The call option is valued at \$14.22 per share and the put option at \$5.89 per share. The results are the same when all inputs are expressed in annual terms. Any timeframe can be used as long as all inputs are consistent.

Example 3: This example is Example 12.7 from *Options, Futures and Other Derivatives* (5th Edition) by John C. Hull (Prentice Hall, 2002).

The stock price six months from the expiration of an option is \$42, the exercise price of the option is \$40, the risk-free rate is 10% per year and the volatility is 20% per year. What are the call and put option values?

Solution:



Call Price =
4.76

Figure 6



Put Price =
0.81

Figure 7

Answer: The call option is valued at \$4.76 per share and the put option at \$0.81 per share. Note that the six month time until maturity was converted to 0.5 years.