

OPTIONS CALCULATOR QUICK GUIDE



Table of Contents

Introduction	3
Valuing options	4
Examples	6
Valuing an American style non-dividend paying stock option	6
Valuing an American style dividend paying stock option	7
Valuing a European style index option	8
Valuing a European style currency option	9
Understanding the option sensitivities	10
Glossary	13

Introduction

The Montréal Exchange option calculator is an educational tool intended to assist individual investors and professionals in computing the theoretical value of options and learning how options work. The options calculator is not intended to provide investment advice and is not designed to be used as the basis for investment or risk management decisions.

The options calculator evaluates the premium of Canadian equity, ETF, index and currency options, for either American or European style exercise style, with or without dividends. Investors can use delayed quotes from an existing options contract or use fictional data to simulate price behaviours.

The full list of options eligible assets can be found on the MX website at http://www.m-x.ca/nego_liste_en.php

If you are unfamiliar with certain terms used throughout the guide, we invite you to consult the glossary on page 13.

Valuing options

You can calculate the theoretical price of an option by accessing the option calculator at http://www.m-x.ca/marc_options_calc_en.php and following the steps below.

The option calculator will appear as follows when the user accesses it for the first time. Most fields are left blank for the user to enter the information specific to the option they wish to value. If you choose to use the blank calculator, the first step involves specifying the exercise style of the option, American or European style.

At the Montréal Exchange, the S&P/TSX 60 Index options (SXO) are European style; whereas, the iShares S&P/TSX 60 Index Fund (XIU) options are American style. All the standard equity options, including options on stocks and exchange-traded funds (ETF), are American style. It is also important to note that currency options, specifically options on the US dollar (USX), are also European style.

All contract specifications can be found via the following links:

Equity options	http://www.m-x.ca/produits_options_actions_en.php
ETF Options	http://www.m-x.ca/produits_options_finb_en.php
Currency options	http://www.m-x.ca/produits_options_devises_en.php
Index options (SXO)	http://www.m-x.ca/produits_indices_sxo_en.php

Options Calculator



[Legal](#) 

Select an option

Type: options

Option Calculator

Inputs

<p>American * <input checked="" type="radio"/> European * <input type="radio"/></p> <p>Type of Underlying * <input type="text" value="Stock/ETF"/> 1</p> <p>Option Type * <input type="text" value="Call"/> 2</p> <p>Expiration Date * <input type="text"/> <input type="button" value="📅"/> 3</p> <p>Days to Expiration * <input type="text" value="Enter Value"/></p> <p>Strike Price (\$) * <input type="text" value="Enter Value"/> 4</p>	<p>Underlying Price (\$) * <input type="text" value="Enter Value"/> 5</p> <p>Volatility (%) <input type="text" value="Enter Value"/> 6</p> <p>Interest Rate (%) <input type="text" value="Enter Value"/> 7</p> <p>Dividend Amount (\$) <input type="text" value="Enter Value"/> 8</p> <p>Dividend Frequency <input type="text" value="Annual"/></p> <p>Expected Dividend Date <input type="text"/> <input type="button" value="📅"/></p>
---	---

No of steps (max 100)

* Modifying any of these fields will unlink the selected option

Users will then have to enter the following additional inputs:

- 1** the **underlying type** (Stock/ETF, Index or Currency);
- 2** the **option type** (call or put);
- 3** the **expiration month** or the **days** to expiry
- 4** the **strike price** of the option;
- 5** the current level of the index or the **current price** of the stock underlying the option;
- 6** the **volatility** (you may use your own estimation or the value provided by your broker or any other financial source);
- 7** the **annual interest rate**; the risk-free interest rate usually measured by the annualized Treasury Bill rate for the period corresponding to the maturity of the option which you are evaluating. For instance, for a three-month option, use a 90-day rate;
- 8** for equity options, the quarterly **dividend amount** and the **next dividend date**; for dividend paying stock options and American style options, we use the numerical binomial model (Cox, Ross and Rubinstein, 1979). You can select the number of tree steps (between 1 and 100, the default is 30). Given that all other variables remain constant, the higher the number of steps, the greater the accuracy of the theoretical price generated by the option calculator; for European style options, we use the analytical model of Black and Scholes (1973).

Examples

Example 1: Valuing an American style non-dividend paying stock option

In this example an investor wishes to value an American style equity call option maturing in 90 days with a strike price of \$90, on a non-dividend paying stock, with a current price of \$100. Annual volatility is estimated at 20% and the annual risk-free rate of interest is 5% on the 90-day period. In order to obtain the theoretical value of the option, the investor would select American as the option exercise style, select Stock/ETF as the underlying, pick call as the option type and enter the following remaining inputs in the option calculator as follow:

Option Calculator

Inputs

American * European *

Type of Underlying *

Option Type *

Expiration Date *

Days to Expiration *

Strike Price (\$) *

Underlying Price (\$) *

Volatility (%)

Interest Rate (%)

Dividend Amount (\$)

Dividend Frequency

Expected Dividend Date

No of steps (max 100)

* Modifying any of these fields will unlink the selected option

APPLY CHANGES

\$11.65	0.8913	0.0190	0.0876	-0.0210	0.1910
THEOR. PRICE:	DELTA:	GAMMA:	VEGA:	THETA:	RHO:

Implied Volatility

Option Price (\$) **CALCULATE**

IMP. VOL.:

Once all the variables are entered in the option calculator, the investor can press on apply changes to generate the theoretical call value, which in this particular example, corresponds to \$11.65.

Example 2: Valuing an American style dividend paying stock option

In this example an investor would like to value an American style equity put option maturing in 120 days with a strike price of \$50, on a dividend paying stock, with a current price of \$45. Annual volatility is estimated at 30%, the annual risk-free rate of interest is 5% on the 120-day period and the underlying stock pays a quarterly dividend of \$0.50 before expiration. In order to obtain the theoretical value of the option, the investor would select American as the option exercise style, select Stock/ETF as the underlying, pick put as the option type and enter the following remaining inputs in the option calculator as follow:

Option Calculator

Inputs

American * European *

Type of Underlying * Stock/ETF

Option Type * Put

Expiration Date * 18/01/2014

Days to Expiration * 120

Strike Price (\$) * 50.00

Underlying Price (\$) * 45.00

Volatility (%) 30.00

Interest Rate (%) 5.00

Dividend Amount (\$) 0.50

Dividend Frequency Quarterly

Expected Dividend Date 02/12/2013

No of steps (max 100) 30

* Modifying any of these fields will unlink the selected option

APPLY CHANGES

\$6.23	-0.7077	0.0473	0.0849	-0.0064	-0.0918
THEOR. PRICE:	DELTA:	GAMMA:	VEGA:	THETA:	RHO:

Implied Volatility

Option Price (\$) **0.33** **CALCULATE**

-
IMP. VOL.:

Once all the variables are entered in the option calculator, the investor can press on apply changes to generate the theoretical put value, which in this particular example, corresponds to \$6.23.

Examples

Example 3: Valuing a European style index option

In this example the investor wishes to value a European style index call option maturing in 60 days with a strike price index level of 740 while the index is currently trading at a level of 735. Annual volatility is estimated at 15% and the annual risk-free rate of interest is 5% on the 60-day period. In order to obtain the theoretical value of the option, the investor would select European as the option exercise style, select index as the underlying, pick call as the option type and enter the following remaining inputs in the option calculator as follow:

Option Calculator

Inputs

American * European *

Type of Underlying *

Option Type *

Expiration Date *

Days to Expiration *

Strike Price (\$) *

Underlying Price (\$) *

Volatility (%)

Interest Rate (%)

Continuous Dividend Yield (%)

* Modifying any of these fields will unlink the selected option

APPLY CHANGES

\$18.35 THEOR. PRICE:	0.5216 DELTA:	0.0089 GAMMA:	1.1871 VEGA:	-0.1984 THETA:	0.6000 RHO:
---------------------------------	-------------------------	-------------------------	------------------------	--------------------------	-----------------------

Implied Volatility

Option Price (\$)

CALCULATE

-
IMP. VOL.:

Once all the variables are entered in the option calculator, the investor can press on apply changes to generate the theoretical call value, which in this particular example, corresponds to \$18.35.

Example 4: Valuing a European style currency option

In this example has an investor wishes to value a European style currency put option maturing in 180 days with a strike price of 100.00 cents while the underlying currency is currently trading at 102.50 cents. Annual volatility is estimated at 20% and the annual risk-free rate of interest is 2.5% on the 180-day period. In order to obtain the theoretical value of the option, the investor would select European as the option exercise style, select currency as the underlying, pick put as the option type and enter the following remaining inputs in the option calculator as follow:

Option Calculator

Inputs

American * European *

Type of Underlying *

Option Type *

Expiration Date *

Days to Expiration *

Strike Price (\$) *

Underlying Price (\$) *

Volatility (%)

Interest Rate (%)

* Modifying any of these fields will unlink the selected option

APPLY CHANGES

\$3.97	-0.3693	0.0262	0.2716	-0.0122	-0.2062
THEOR. PRICE:	DELTA:	GAMMA:	VEGA:	THETA:	RHO:

Implied Volatility

Option Price (\$) **CALCULATE**

IMP. VOL.:

Once all the variables are entered in the option calculator, the investor can press on apply changes to generate the theoretical put value, which in this particular example, corresponds to 3.97 cents.

Understanding the Option Sensitivities

The “Greeks” measure the change in value of an option due to a change in one of the pricing variables. The “Greeks”—also called measures of sensitivity—measure how changes in each variable affect the option price. The option “Greeks” are important for two reasons: 1) they are used by professional option traders to create and hedge option positions and 2) they are used by investors to estimate how a change in market conditions will affect the value of their option positions. The “Greeks” are also used to help select appropriate options for implementing various option strategies.

Greek letters are derived from the Black-Scholes option pricing model and represent the stochastic calculus derivatives with respect to the variables below. Using the inputs from example 1: Valuing an American style non-dividend paying stock option, the options calculator generates the following options Greeks.

\$11.65 THEOR. PRICE:	0.8913 DELTA:	0.0190 GAMMA:	0.0876 VEGA:	-0.0210 THETA:	0.1910 RHO:
---------------------------------	-------------------------	-------------------------	------------------------	--------------------------	-----------------------

Delta

If the price of the stock rises, the call option premium will tend to rise and the put option premium will decrease, all else being equal. However, the prices for all options will not increase or decrease at the same rate.

Delta, Δ , is the fourth letter of the Greek alphabet, and generally thought of as the most important “Greek” for the measure of hedging sensitivity. Delta is the change in option price for a small change in the underlying stock price, assuming that all of the other option pricing variables remain constant.

$$\Delta = \frac{C_t - C_o}{S_t - S_o} = \frac{\text{rate of change of option price}}{\text{rate of change of stock price}}$$

Where: C_o = is the original option price
 C_t = is the price of the option after the price of the underlying changes to S_t
 S_o = is the original price of the underlying
 S_t = is the new price of the underlying

As the above equation indicates, delta estimates how much the option price will change if the value of the underlying changes.

In example 1, the call option has a delta of 0.8913, which means that a \$1.00 (one unit) increase in the price of the stock will increase the option premium by \$0.8913.

For call options, delta is a positive value in the range (0; +1); for put options, delta is negative and in the range (-1; 0). For in-the-money options, delta tends toward +1 for a call and -1 for a put. At-the-money options have a delta of ± 0.50 . Lastly, out-of-the-money options have a delta that nears zero.

Gamma

Gamma as a rate of change in delta

After delta, gamma is one of the most used parameters. Gamma, γ , is the rate of change of delta, for a given change in the price of the underlying.

$$\gamma = \frac{\Delta_t - \Delta_o}{S_t - S_o} = \frac{\text{rate of change of } \Delta}{\text{rate of change of stock price}}$$

Let's go back to our previous example. Delta is 0.8913 and gamma is 0.0190. A \$1.00 (one unit) increase in the price of the stock will increase the option premium by \$0.8913 and delta will increase from 0.8913 to 0.9103.

Uses for gamma

Gamma has two main uses. The first use of gamma is that it gives a measure of the accuracy of the delta equation for a small change in price of the underlying. The second use of gamma is that it gives traders a gauge for determining how frequently they need to update or renew their delta hedges on their option positions. The higher the gamma of a position, the more frequently (and carefully) traders would recalculate their deltas and re hedge their positions.

Vega

Interestingly, unlike the other option "Greeks", vega is not an actual Greek letter. Vega, v , measures the change in price of an option for a small change in the level of implied volatility.

$$v = \frac{c_t - c_o}{\sigma_t - \sigma_o} = \frac{\text{change in price of option}}{\text{change in level of volatility}}$$

Vega gives an idea of an option's sensitivity to perceived changes in market volatility. Using again our example, if the annual volatility moves down from 20% to 19%, the call premium decreases by \$0.0876. If the volatility was to increase by 1% from 20% to 21%, the call premium would increase by \$0.0876. Note that the same relationship applies to put options. An option position with a high vega will have a high sensitivity to changes in volatility. The higher the vega of an option, the greater the increase in the option price if the volatility increases.

Like delta and gamma, vega is also an important measure for hedging option positions. To hedge their position against changes in volatility, traders will calculate the vega of their option position, and buy or sell other options with an offsetting vega value. There is one aspect of vega hedging that differs from delta or gamma hedging. With delta and gamma hedging, traders can hedge their position by buying or selling shares of the underlying asset. The only way to vega hedge, however, is to buy or sell other options.

Theta

Theta, θ , is the rate of change in price of an option for a small change in time to maturity. Theta is sometimes called the “rate of decay” of an option, since the value of an option declines (all else being equal) as the time to maturity approaches.

$$\theta = \frac{c_t - c_{t_0}}{t - t_0} = \frac{\text{change in price of option}}{\text{change in time to maturity}}$$

Like the other option “Greeks”, theta can be used to estimate how the value of an option will change as the time to maturity changes. Based on our previous example, if the days to expiry decrease from 90 days to 80 days, the call premium decreases by 10 days X \$0.021 = \$0.21. Time decay affects call and put options in the same way.

Although theta is not a major factor when there is a long time remaining to maturity, it becomes increasingly important as the time to maturity nears. The implication for investors is that they should expect the value of their options to fall more quickly as the maturity date approaches.

Rho

Rho, ρ , is the final “Greek” that we will examine. Rho is the change in value of an option for a small change in value of the risk-free interest rate.

$$\rho = \frac{c_{r_1} - c_{r_2}}{r_1 - r_2} = \frac{\text{change in price of option}}{\text{change in risk-free interest rate}}$$

For stock options, ρ is relatively unimportant. The value of stock options changes very little for reasonable changes in interest rates. Rho is much more important for currency options, as changes in the interest rate can directly affect the exchange rate between two currencies.

We now have a general view of the option “Greeks”, which measure how the value of an option changes as the pricing variables change.

Glossary

Expressions used

Synonyms and explanations

American option	Option that the holder may exercise at any time up to and including the expiry date.
Assignment	An assignment takes place when a holder exercises an option. The option writer receives an exercise notice that obliges him to sell (in the case of a call option) or buy (in the case of a put option) the shares at the stipulated strike price.
At-the-money option	When the option strike price and share price are identical.
Call	Option contract that gives the holder the right to buy and obliges the writer to sell a specified number of shares at a specified strike price, any time before the contract expiry date.
European option	Option which the holder can only exercise on the expiry date.
Expiry date	Date on which the option ceases to exist. Options expire the third Friday of the expiry month.
Implied Volatility	The volatility built into the price of an option in the market. It determines market consensus about the probable volatility of the underlying stock in the future
In-the-money option	When the strike price of a call (or put) option is lower (or higher) than the share price.
Intrinsic value	Positive difference between the stock price and the strike price of a call option or between the strike price of a put option and the stock price. By definition, the intrinsic value cannot be negative.
Last trading day	Date on which the option ceases trading; a business day, usually the third Friday of the expiry month, at 4:00 p.m. (EST).
Option class	All option contracts (call and put options) on the same security.
Option series	All options in the same class that have the same strike price and same expiry date.
Option type	Classification of an option contract as a call option or a put option.
Out-of-the-money option	When the strike price of a call (or put) option is higher (or lower) than the share price.
Premium, option premium	Price of the option. Price the buyer pays the seller for the rights associated with the option contract.

Put	Option contract that gives the holder the right to sell and obliges the writer to buy a specified number of shares at a specified strike price, any time before the contract expiry date.
Strike price	Or exercise price. Specified price at which the holder of an option can buy (call option) or sell (put option) the underlying stock.
Theoretical price	The estimated value of an option derived from a mathematical model
Time value	Or time premium. Portion of the premium that represents the remaining time until the expiry of the option contract and the fact that the factors which determine the value of the option premium can change during this period. The time value is equal to the difference between the option premium and the intrinsic value. The time value is usually positive and decreases with the passage of time.
To exercise an option	To exercise an option represents the process by which the holder exercises his right to buy (in the case of a call option) or sell (in the case of a put option) according to the terms specified in the contract.
Underlying	The asset or security Subject to being purchased or sold upon exercise of the option contract
Volatility	Variability of a stock as measured by the standard deviation of its return. A measure of the tendency of the share price to rise or fall.

MONTRÉAL EXCHANGE CONTACT DETAILS:

Montréal Exchange

Tour de la Bourse
P.O. Box 61 - 800 Victoria Square
Montréal, Quebec H4Z 1A9
Canada

T 1 866 871-7878

info@tmx.ca



m-x.tv



OptionMatters.ca



m-x.ca/twitter



m-x.ca/facebook



m-x.ca/linkedin



m-x.ca/rss

This document is provided on a general information basis only. The information provided in this document, including financial and economic data, quotes and any analysis or interpretation thereof, is provided solely on an information basis and shall not be interpreted in any jurisdiction as an advice or a recommendation with respect to the purchase or sale of any derivative instrument or underlying security or as a legal, accounting, financial or tax advice. Bourse de Montréal Inc. recommends that you consult your own experts in accordance with your needs. All references in this document to specifications, rules and obligations concerning a product are subject to the Rules and Policies of Bourse de Montréal Inc. and its clearinghouse, the Canadian Derivatives Clearing Corporation. Although care has been taken in the preparation of this document, Bourse de Montréal Inc. and/or its affiliates take no responsibility for errors or omissions and reserve the right to amend or review, at any time and without prior notice, the content of this document.

Bourse de Montréal Inc., its affiliates, directors, officers, employees and agents will not be liable for damages, losses or costs incurred as a result of the use of any information appearing in this document.

Montréal Exchange and the Montréal Exchange logo are registered trademarks of Bourse de Montréal Inc.

Printed in Canada

© Bourse de Montréal Inc., August 2017