# **What Are Greeks in Finance and How Are TheyUsed?**

## What Are the Greeks?

The variables that are used to assessrisk in the options market are commonlyreferred to as "the Greeks." A Greek symbolisused to designateeach of theserisks.

Each Greek variable is a result of an imperfectassumption or relationship of the option withanotherunderlying variable. Traders use different Greek values, such as delta, theta, and others, to [assess options risk](https://www.investopedia.com/terms/o/omega.asp) and manage option portfolios.

### **KEY TAKEAWAYS**

* The Greeks are symbolsassigned to the variousriskcharacteristicsthat an options position entails.
* The mostcommonGreeksusedinclude the delta, gamma, theta, and vega, which are the first partial derivatives of the options pricing model.
* Greeks are used by options traders and portfolio managers to understand how their options investmentswillbehave as prices move, and to hedgetheir positions accordingly.1

## Understanding the Greeks

Greeksencompass many variables. Theseinclude delta, theta, gamma, vega, and rho, amongothers. Each one of theseGreeks has a numberassociatedwithit, and thatnumber tells traders something about how the option moves or the riskassociatedwiththat option. The primaryGreeks (delta, vega, theta, gamma, and rho) are calculatedeach as a first partial derivative of the options pricing model (for instance, the [Black-Scholes model](https://www.investopedia.com/terms/b/blackscholes.asp)).21

The number or value associatedwith a Greek changes over time. Therefore, sophisticated options traders maycalculatethese values daily to assessany changes thatmay affect their positions or outlook, or simply to check if their portfolio needs to be [rebalanced](https://www.investopedia.com/terms/r/rebalancing.asp). Below are several of the main Greeks traders look at.1

## Delta

[Delta](https://www.investopedia.com/terms/d/delta.asp) (Δ) represents the [rate of change](https://www.investopedia.com/terms/r/rateofchange.asp) between the option'sprice and a $1 change in the underlyingasset's price. In otherwords, the pricesensitivity of the option is relative to the underlyingasset. The delta of a call option has a range between 0 and 1, while the delta of a [put option](https://www.investopedia.com/terms/p/putoption.asp) has a range between 0 and -1. For example, assume an investoris long a call option with a delta of 0.50. Therefore, if the underlying stock increases by $1, the option'spricewouldtheoreticallyincrease by 50 cents.1

For options traders, delta alsorepresents the [hedge ratio](https://www.investopedia.com/terms/h/hedgeratio.asp) for creating a [delta-neutral](https://www.investopedia.com/terms/d/deltaneutral.asp) position.3 For example, if youpurchase a standard American call option with a 0.40 delta, youwillneed to sell 40 shares of stock to befullyhedged. Net delta for a portfolio of options canalsobeused to obtain the portfolio'shedge ratio.1

A lesscommon [usage of an option's delta](https://www.investopedia.com/articles/optioninvestor/03/021403.asp) is the currentprobabilitythat the option will expire [in-the-money](https://www.investopedia.com/terms/i/inthemoney.asp). For instance, a 0.40 delta call option today has an implied 40% probability of finishing in-the-money.1

## Theta

[Theta](https://www.investopedia.com/terms/t/theta.asp) (Θ) represents the rate of change between the option price and time, or time sensitivity—sometimesknown as an option's time decay. Thetaindicates the amount an option'spricewoulddecrease as the time to [expiration](https://www.investopedia.com/terms/e/expirationdate.asp) decreases, all elseequal. For example, assume an investoris long an option with a theta of -0.50. The option'spricewoulddecrease by 50 cents everydaythat passes, all elsebeingequal.

Thetaincreaseswhen options are at-the-money, and decreaseswhen options are in- and out-of-the money. Options closer to expiration also have accelerating time decay. Long calls and long putswillusually have negativetheta; short calls and short putswill have positive theta. By comparison, an instrument whose value is not eroded by time, such as a stock, would have zerotheta.

## Gamma

[Gamma](https://www.investopedia.com/terms/g/gamma.asp) (Γ) represents the rate of change between an option's delta and the underlyingasset'sprice. This iscalled second-order (second-derivative) pricesensitivity. Gamma indicates the amount the delta would change given a $1 move in the underlyingsecurity. For example, assume an investoris long on a [call option](https://www.investopedia.com/terms/c/calloption.asp) on hypothetical stock XYZ. The call option has a delta of 0.50 and a gamma of 0.10. Therefore, if stock XYZ increases or decreases by $1, the call option's delta wouldincrease or decrease by 0.10.1

Gamma isused to determine how stable an option's delta is: Higher gamma values indicatethat delta could change dramatically in response to evensmallmovements in the underlying'sprice. Gamma ishigher for options that are [at-the-money](https://www.investopedia.com/terms/a/atthemoney.asp) and lower for options that are in- and out-of-the-money and accelerates in magnitude as expiration approaches. Gamma values are generallysmaller the furtherawayfrom the date of expiration; options with longer expirations are less sensitive to delta changes. As expiration approaches, gamma values are typicallylarger, as price changes have more impact on gamma.

Options traders mayopt to not only [hedge delta but also gamma](https://www.investopedia.com/terms/d/deltagamma-hedging.asp) in order to be [delta-gamma neutral](https://www.investopedia.com/articles/optioninvestor/07/gamm_delta_neutral.asp), meaningthat as the underlyingprice moves, the delta willremain close to zero.

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## Vega

[Vega](https://www.investopedia.com/terms/v/vega.asp) (ν) represents the rate of change between an option's value and the underlyingasset'simpliedvolatility. This is the option'ssensitivity to volatility. Vega indicates the amount an option'sprice changes given a 1% change in impliedvolatility. For example, an option with a vega of 0.10 indicates the option's value isexpected to change by 10 cents if the impliedvolatility changes by 1%.

Becauseincreasedvolatilityimpliesthat the underlying instrument is more likely to experienceextreme values, a rise in volatilitywillcorrespondinglyincrease the value of an option. Conversely, a decrease in volatilitywillnegatively affect the value of the option. Vega is at its maximum for at-the-money options that have longer times until expiration.

*Greek-languagebuffswill point out thatthereis no actual Greek lettervega.There are varioustheories about how thissymbol, whichrepresents the Greek letter nu, founditswayinto stock-trading lingo.*

## Rho

[Rho](https://www.investopedia.com/terms/r/rho.asp) (ρ) represents the rate of change between an option's value and a 1% change in the [interest rate](https://www.investopedia.com/terms/i/interestrate.asp). This measuressensitivity to the interest rate. For example, assume a call option has a rho of 0.05 and a price of $1.25. If interest rates rise by 1%, the value of the call option wouldincrease to $1.30, all elsebeingequal. The opposite istrue for put options. Rho isgreatest for at-the-money options with long times until expiration.

## Minor Greeks

SomeotherGreeks, whicharen'tdiscussed as often, are [lambda](https://www.investopedia.com/terms/l/lambda.asp), epsilon, [vomma](https://www.investopedia.com/terms/v/vomma.asp), vera, [zomma](https://www.investopedia.com/terms/z/zomma.asp), and ultima. TheseGreeks are second- or third-derivatives of the pricing model and affect thingssuch as the change in delta with a change in volatility and so on. They are increasinglyused in options trading strategies, as computer software canquicklycompute and account for thesecomplex and sometimesesotericriskfactors.

## ImpliedVolatility

Impliedvolatilityis not a Greek, but itisrelated to them. This value forecasts how volatile the stock underlying an option willbe in the future. [Impliedvolatility](https://www.investopedia.com/articles/optioninvestor/08/implied-volatility.asp) istheoretical, meaningit shows whatisexpected but is not alwaysdependable. This value isusuallyreflected in the price of an option.

*Impliedvolatilitycan help youjudgewhatassumptionsmarketmakers are using to set theirbid and askprices.*

Impliedvolatilityisoftenprovided on options trading platforms, ratherthanbeingsomethingthat traders need to calculate for themselves. This isbecausemarketmakers use impliedvolatility to set theirprices, so traders need to know how volatile thosemarketmakersthink an underlying stock willbe. Impliedvolatilityisbased on a number of factors, including:

* Upcomingearnings reports
* Pendingproductlaunches
* Expectedmergers or acquisitions

Comparing an underlyingstock'shistoricvolatility to itsimpliedvolatilitycan help youjudgewhether the option you are consideringispricedlow or high. If the impliedvolatilityishigherthan normal, thisgenerallybenefits option sellers. Impliedvolatilitythatislowerthan normal, on the other hand, usuallybenefits option buyers.

## **What Are the Greeks In Options?**

The five main Greeks in options trading are delta (Δ), theta (Θ), gamma (Γ), vega (ν), and rho (ρ). Each Greek has a number value thatprovides information about how the option ismoving or the riskassociatedwithbuying or sellingthat option. These values change over time, sosavvy traders will check themdaily or multiple times a daybeforemakingtrades.

## **Is a High Delta Good for Options?**

A rise in the price of the underlying stock is positive for call options but not for put options. This meansthat the Delta value is positive for call options and negative for put options.

## **Which Greek MeasuresVolatility?**

Thetameasures the rate of decline in the value of an option over time. This isitssensitivity to impliedvolatility. Impliedvolatilityis a separate value thatis not a Greek but isoftenusedalongsidethem to value an option.

## **Are Greeks Part of the Price of an Option?**

The Greeks are not part of the price of an option. They are used to estimatewhat the price of an option might do in response to changes in the market or the value of the underlying stock. This can help youjudge the underlyingrisk of an option and whetheritis a good investment or not.

## The Bottom Line

In options investing, the Greeks are values thatestimate the variousriskcharacteristics of an options position. They tell traders how an option islikely to react to changes in the market, such as a change in the price of the underlyingasset. Greekscanbeused to judge the riskiness of an investment in that option.

The Greeksgettheirnamebecausethey are represented by lettersfrom the Greek alphabet. The five main ones are delta, gamma, vega, theta, and rho.There are also minor Greeks, such as lambda, epsilon, vomma, vera, zomma, and ultima. The use of these minor Greeksisbecoming more commonsince computers canquicklycalculatecomplex variables for traders.

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