1 Delta and Gamma

1 The five Greeks

There are five primary factor sensitivities that we will cover in this book.

![The Greeks against Spot](image)

*Figure 13* The five Greeks plotted against changing spots
*Source: FinanceTrainingCourse.com*

The image above presents a plot of the five price-factor sensitivities for a European call option. The first four are linked to four option price determinants – the underlying spot price, volatility, interest rates and time to maturity (shown in brackets with the corresponding Greek below).

**Delta (Spot Price)** – Measures the change in the value of the option due to a change in price of the underlying.

**Vega (Volatility)** – Measures the change in the value of the option due to a change in volatility of the underlying.
Rho (Interest Rates) – Measures the change in the value of the option due to a change in interest rates.

Theta (Time to Expiry) – Measures the change in the value of the option due to a change in the time to expiry or maturity.

The fifth and final sensitivity is a little different, as it measures not a change in the option price, but in one of the sensitivities, based on a change in the price of the underlying.

Gamma – Measures a change in the value of Delta, based on a change in the price of the underlying. If you are familiar with fixed income analytics, think of Gamma as convexity.

As promised earlier, we won’t hit you with any equations. However, a quick notation summary is still required to appreciate the shape of the curves you are about to see. For a review of the notation, see Appendix 2.

Delta, Vega, Theta and Rho are first-order changes, while Gamma is a second-order change. If you take a quick look at the plot of the five factors presented above, you will see that the shape of the curves are similar for Delta and Rho (the slanting S) and similar for Gamma, Vega and Theta (the hill or inverted U). We will revisit the discussion on shapes later in the book.

The other Greeks

Taleb mentions a number of additional Greeks with different utility in his book Dynamic Hedging. They include:

- Shadow Gamma. A Gamma calculation that takes into account changes in volatility in addition to changes in the price of the underlying.
- Omega. Option Duration; the expected life of vanilla American options or expected exit for binaries and knockouts.
- Alpha. Gamma Rent; Theta per Gamma ratio.
- Modified Vega. Weighted average Vega by maturity buckets, taking into consideration the maturity bucket volatility.
- Modified Theta. Price of option at current volatility less the price of the same option a day later at the day-later maturity.
- Vanna and Volga. The two cross Greeks increasingly come up w.r.t. to FX options, and are discussed further in the hedging higher-order Greeks section of this book.

Why do we need option price sensitivities?

A vanilla call option has six determinants of value. If we want to guess the impact of a small change in any of these factors on option value, we have two choices. One is to plug in the revised value in the Black-Scholes model (also known as Full Valuation) and get the accurate price; the other is to do a quick and dirty estimate based on how the value of the option will react given the change in this specific factor.