Finance

In mathematical finance, *The Greeks* are quantities often used in risk management to represent the sensitivity of the price of a derivative, such as an option, to changes in underlying parameters on which the value of a financial instrument is dependent. This can include the sensitivity of a derivative to changes in the price of the underlying asset, the implied volatility, time-value decay, or other factors.

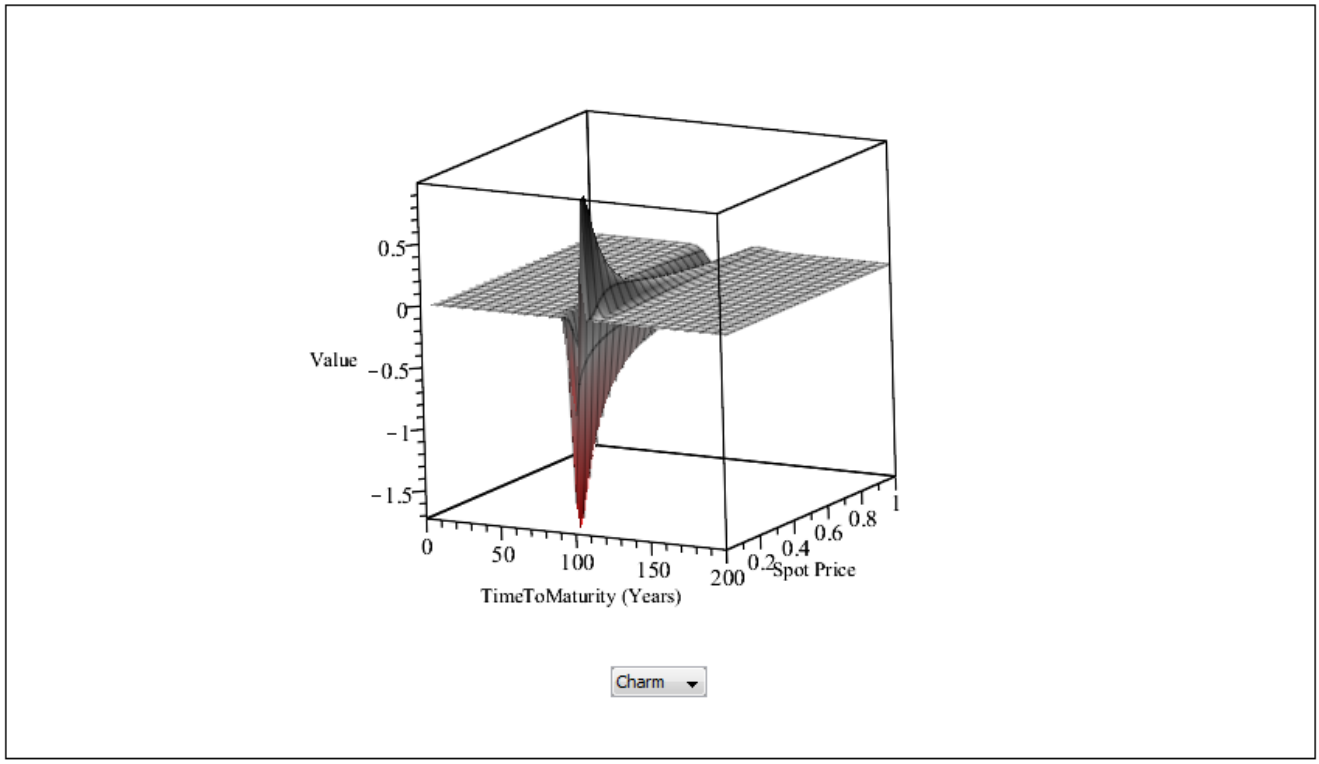
Maple 2015 includes 10 new commands for computing values for the Greeks, which appear in bold in the table below. The following table shows the definition of the various Greeks in terms of the underlying parameters in the first row. For example, *Delta* is the sensitivity of the derivative value (V) to the spot price (S), expressed as $\frac{\partial}{\partial S} V$. The first order Greeks are shown in the first row in green, the second order Greeks are in rows two through four in blue, and the third order Greeks are in rows five and six in pink.

	Spot Price (S)	**Volatility (σ)**	**Time to Expiry (τ)**	**Interest Rate (r)**
Derivative Value (V)	Delta (Δ)	Vega (ν)	Theta (Θ)	Rho (ρ)
Delta (Δ)	Gamma (Γ)	**Vanna**	**Charm**	
Rho (ρ)		**Vera**		
Vega (ν)	**Vanna**	**Vomma**	**Veta**	
Gamma (Γ)	**Speed**	**Zomma**	**Color**	
Vomma		**Ultima**		

A notable omission from the table above is Lambda, which is used as a measure of leverage, namely the percent change in option value per percentage change in the price of the underlying asset, expressed as $\frac{\partial}{\partial S} V \cdot \frac{S}{V}$.

The following plot shows the characteristics for each of the Greeks in terms of time to

maturity, spot price, and value, for a call option with given strike price (K) = 100, volatility (σ) = 0.1, interest rate (r) = 0.05, and paying no dividends.



Other Updates in Finance

With the advances in programmatic content generation, it is now possible to programmatically generate interactive embedded components. Several Maple commands have been updated to utilize this technology, including the Finance:-amortization command, which now returns an embedded datatable when the output option set is to embed:

```
> Finance:-amortization(1000.00, 400.00, 0.075, output = embed) :
```

n	Payment	Interest	Principal	Balance
0	0	0	-1000.00	1000.00
1	400.00	75.00000	325.00000	675.00000
2	400.00	50.62500000	349.3750000	325.6250000
3	350.0468750	24.42187500	325.6250000	0.