Andreas Krause

Properties of option prices

Influences on option values

Influences on option values

- Option values are affected by a large number of parameters

Influences on option values

- Option values are affected by a large number of parameters and knowing these can help to hedge the exposure of the underlying asset

Influences on option values

- Option values are affected by a large number of parameters and knowing these can help to hedge the exposure of the underlying asset
- Option pricing theory allows to analyse the influence these variables have on option values

Influences on option values

- Option values are affected by a large number of parameters and knowing these can help to hedge the exposure of the underlying asset
- Option pricing theory allows to analyse the influence these variables have on option values
- These influences can be used by investors to hedge risks

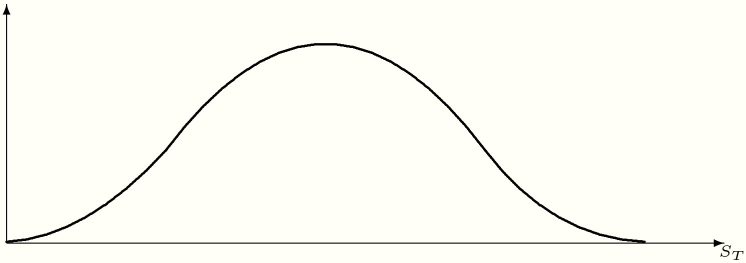
Influences on option values

- Option values are affected by a large number of parameters and knowing these can help to hedge the exposure of the underlying asset
- Option pricing theory allows to analyse the influence these variables have on option values
- These influences can be used by investors to hedge risks

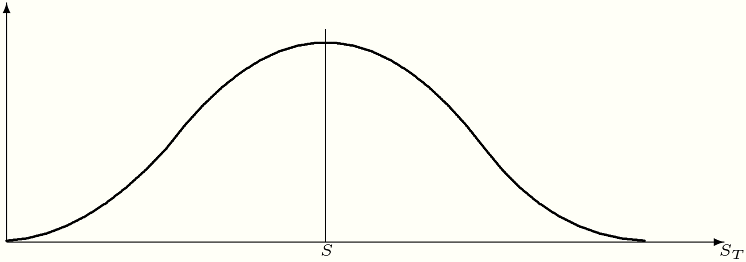
Current asset value

Current asset value

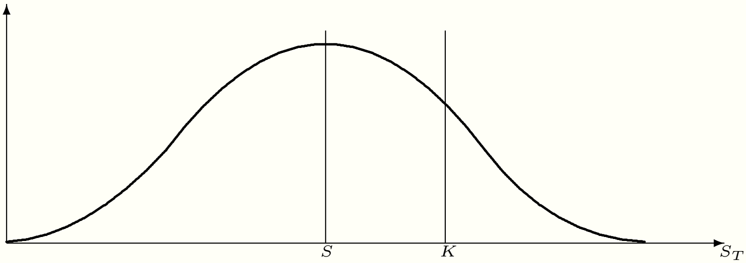
Current asset value



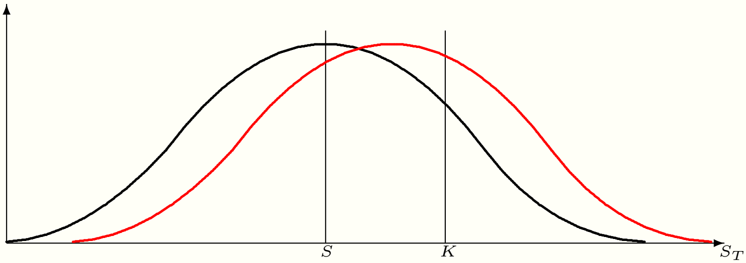
Current asset value



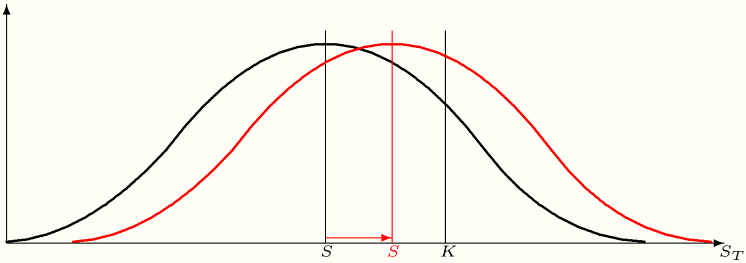
Current asset value



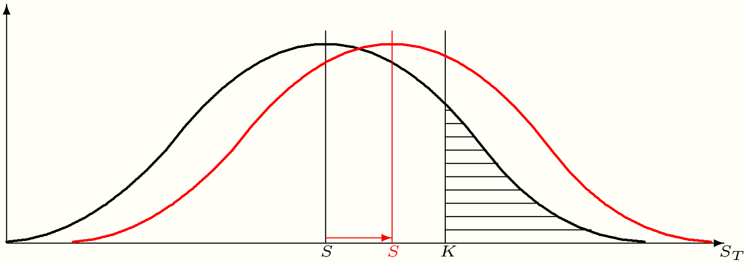
Current asset value



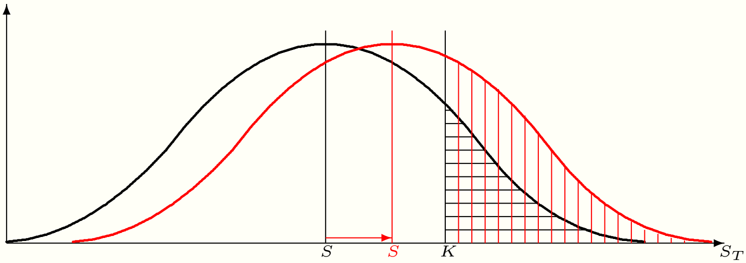
Current asset value



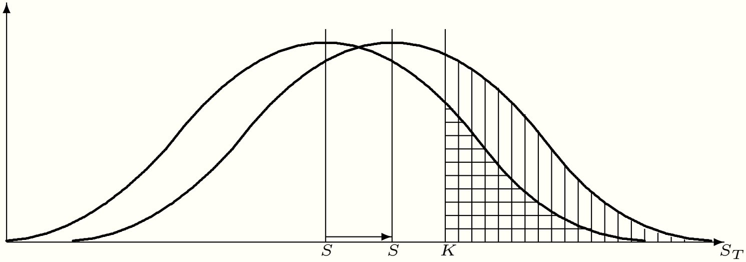
Current asset value



Current asset value

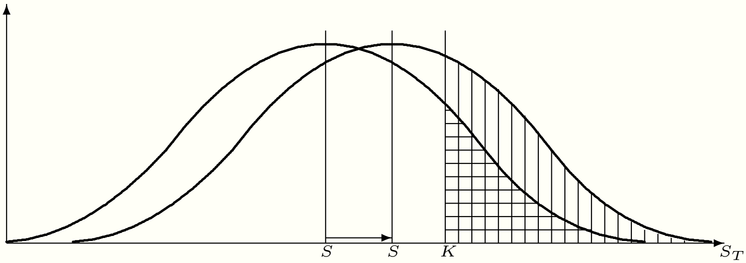


Current asset value



If the current asset value increases, call options become more valuable

Current asset value

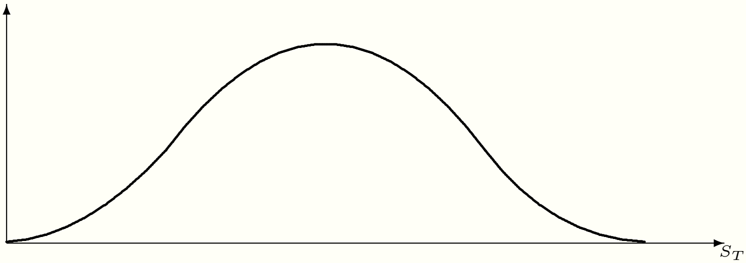


If the current asset value increases, call options become more valuable

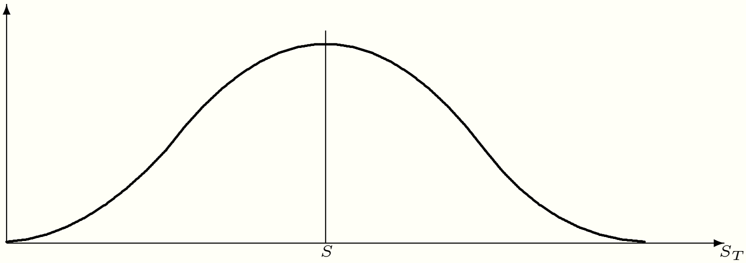
Strike price

Strike price

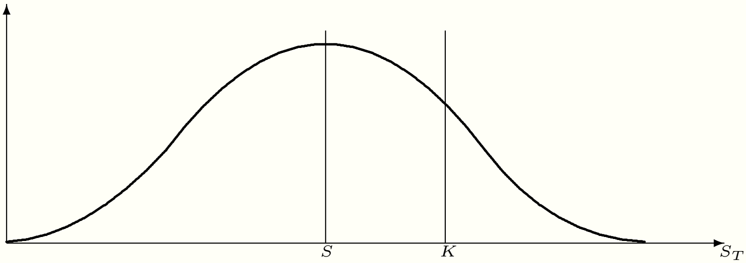
Strike price



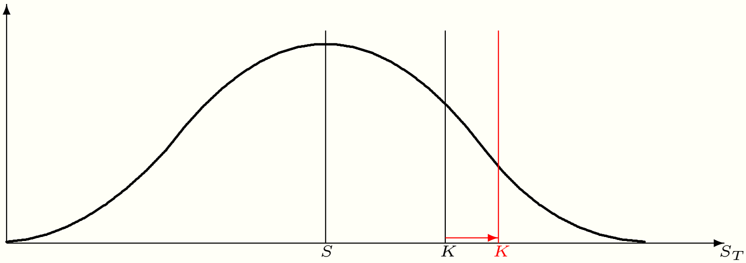
Strike price



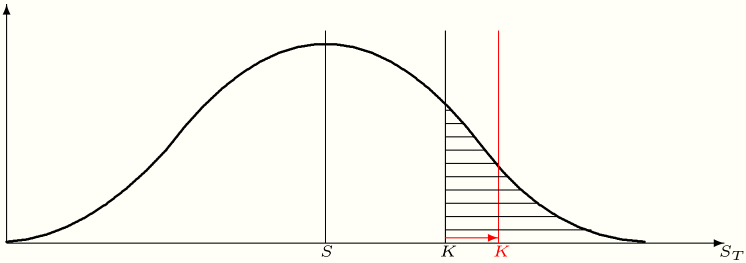
Strike price



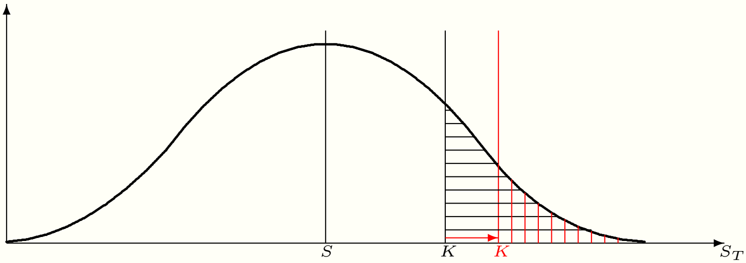
Strike price



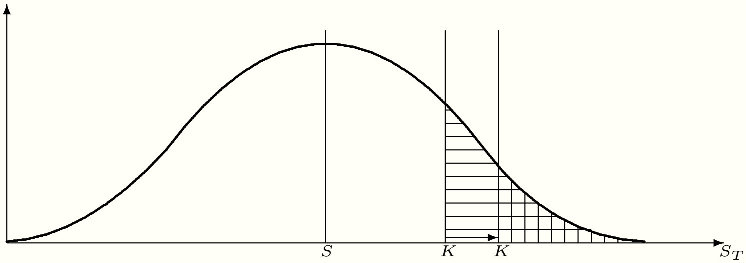
Strike price



Strike price

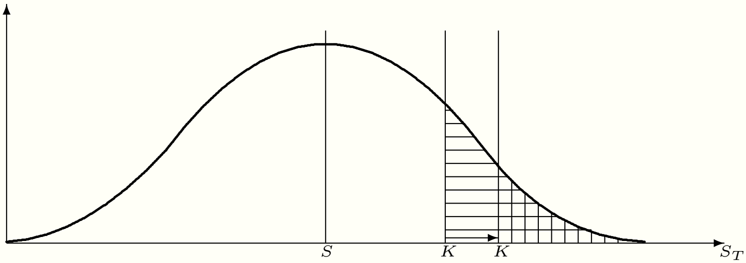


Strike price



If the strike price increases, call options become less valuable

Strike price

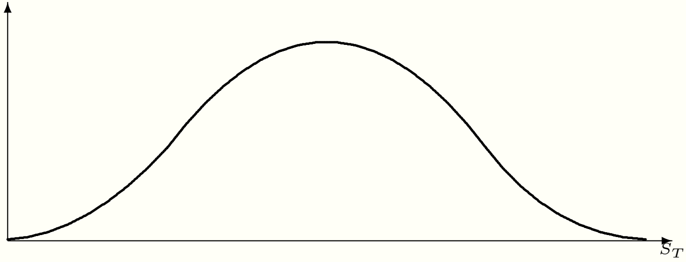


If the strike price increases, call options become less valuable

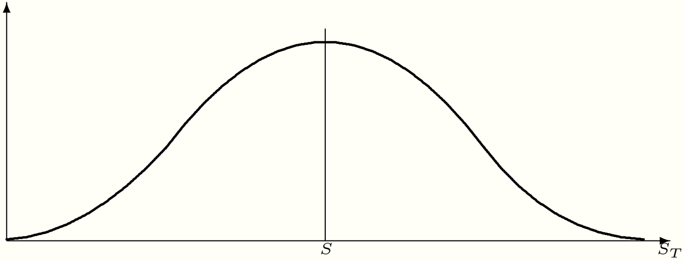
Volatility

Volatility

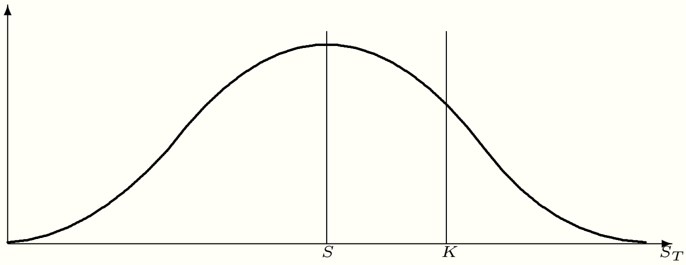
Volatility



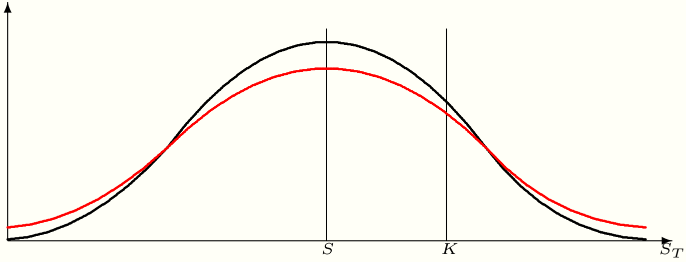
Volatility



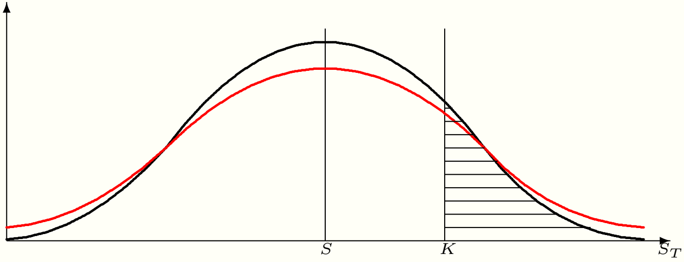
Volatility



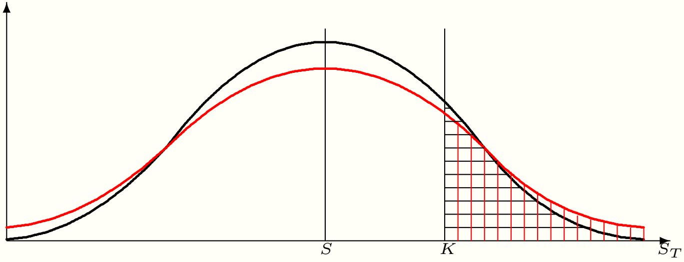
Volatility



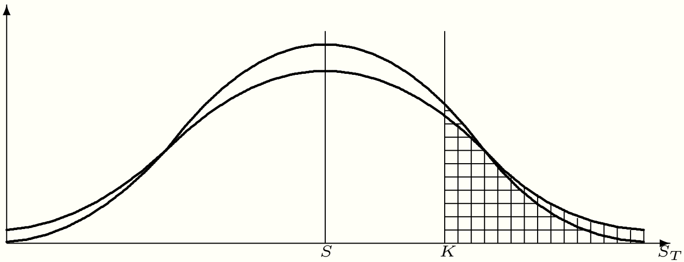
Volatility



Volatility

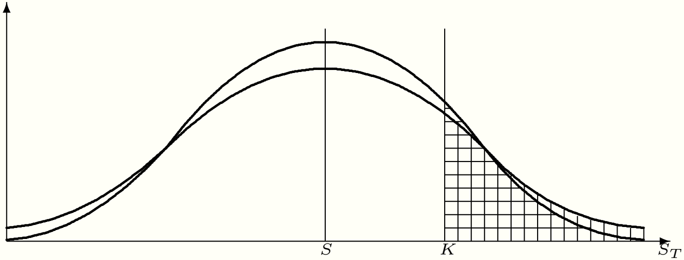


Volatility



If the volatility increases, call options become more valuable

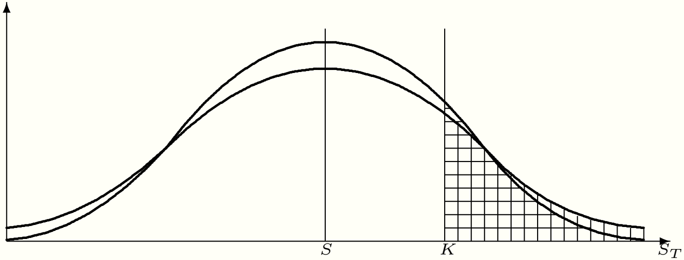
Volatility



If the volatility increases, call options become more valuable

A long time to maturity will increase the variability of the final value and affect the option price in the same way

Volatility



If the volatility increases, call options become more valuable

A long time to maturity will increase the variability of the final value and affect the option price in the same way

Option Greeks

Option Greeks

- The effect of variables have on option prices are known as the Greeks

Option Greeks

- The effect of variables have on option prices are known as the Greeks
- The Greeks measure the marginal effect a variable has on the option price

Option Greeks

- The effect of variables have on option prices are known as the Greeks
- The Greeks measure the marginal effect a variable has on the option price

	Call options	Put options
Delta	$\Delta_C = \frac{\partial C}{\partial S} = N\left(d_1\right)$	$\Delta_P = \frac{\partial P}{\partial S} = N\left(d_1\right) - 1$
Vega	$\nu_C = \frac{\partial C}{\partial \sigma} = Sn\left(d_1\right)\sqrt{T} = \frac{\partial P}{\partial \sigma} = \nu_P$	
Theta	$\theta_C = \frac{\partial C}{\partial T} = -\frac{Sn(d_1)}{2\sqrt{T}} - rKe^{-rT}N\left(d_2\right)$	$\theta_P = \frac{\partial P}{\partial T} = -\frac{Sn(d_1)}{2\sqrt{T}} + rKe^{-rT}N\left(d_2\right)$
Gamma	$\Gamma_C = \frac{\partial^2 C}{\partial S^2} = \frac{n(d_1)}{S\sigma\sqrt{T}} = \frac{\partial^2 P}{\partial S^2} = \Gamma_P$	

Option Greeks

- The effect of variables have on option prices are known as the Greeks
- The Greeks measure the marginal effect a variable has on the option price

	Call options	**Put options**
Delta	$\Delta_C = \frac{\partial C}{\partial S} = N\left(d_1\right)$	$\Delta_P = \frac{\partial P}{\partial S} = N\left(d_1\right) - 1$
Vega	$\nu_C = \frac{\partial C}{\partial \sigma} = Sn\left(d_1\right)\sqrt{T} = \frac{\partial P}{\partial \sigma} = \nu_P$	
Theta	$\theta_C = \frac{\partial C}{\partial T} = -\frac{Sn(d_1)}{2\sqrt{T}} - rKe^{-rT}N\left(d_2\right)$	$\theta_P = \frac{\partial P}{\partial T} = -\frac{Sn(d_1)}{2\sqrt{T}} + rKe^{-rT}N\left(d_2\right)$
Gamma	$\Gamma_C = \frac{\partial^2 C}{\partial S^2} = \frac{n(d_1)}{S\sigma\sqrt{T}} = \frac{\partial^2 P}{\partial S^2} = \Gamma_P$	

Δ-hedging

Δ-hedging

- Investors can use options not only to hedge their final payoff, but also the value of their position at any time

Δ-hedging

- Investors can use options not only to hedge their final payoff, but also the value of their position at any time
- Portfolio value hedged with a put option: $V = S + hP$

Δ-hedging

- Investors can use options not only to hedge their final payoff, but also the value of their position at any time
- Portfolio value hedged with a put option: $V = S + hP$
- Values do not change as the asset value changes: $\frac{\partial V}{\partial S} = 0$

Δ-hedging

- Investors can use options not only to hedge their final payoff, but also the value of their position at any time
- Portfolio value hedged with a put option: $V = S + hP$
- Values do not change as the asset value changes: $\frac{\partial V}{\partial S} = 0$

$\Rightarrow h = \frac{1}{1 - N(d_1)}$

Δ-hedging

- Investors can use options not only to hedge their final payoff, but also the value of their position at any time
- Portfolio value hedged with a put option: $V = S + hP$
- Values do not change as the asset value changes: $\frac{\partial V}{\partial S} = 0$

$\Rightarrow h = \frac{1}{1 - N(d_1)} = -\frac{1}{\Delta_P}$

Δ-hedging

- Investors can use options not only to hedge their final payoff, but also the value of their position at any time
- Portfolio value hedged with a put option: $V = S + hP$
- Values do not change as the asset value changes: $\frac{\partial V}{\partial S} = 0$

$\Rightarrow$ $h = \frac{1}{1-N(d_1)} = -\frac{1}{\Delta_P}$

- This is known as the hedge ratio

Δ-hedging

- Investors can use options not only to hedge their final payoff, but also the value of their position at any time
- Portfolio value hedged with a put option: $V = S + hP$
- Values do not change as the asset value changes: $\frac{\partial V}{\partial S} = 0$

$\Rightarrow$ $h = \frac{1}{1-N(d_1)} = -\frac{1}{\Delta_P}$

- This is known as the hedge ratio
- For each asset, the investor should hold h put options

Δ-hedging

- Investors can use options not only to hedge their final payoff, but also the value of their position at any time
- Portfolio value hedged with a put option: $V = S + hP$
- Values do not change as the asset value changes: $\frac{\partial V}{\partial S} = 0$

$\Rightarrow$ $h = \frac{1}{1 - N(d_1)} = -\frac{1}{\Delta_P}$

- This is known as the hedge ratio
- For each asset, the investor should hold h put options and the value of their combined position does not change as the asset value changes

Δ-hedging

- Investors can use options not only to hedge their final payoff, but also the value of their position at any time
- Portfolio value hedged with a put option: $V = S + hP$
- Values do not change as the asset value changes: $\frac{\partial V}{\partial S} = 0$

$\Rightarrow$ $h = \frac{1}{1-N(d_1)} = -\frac{1}{\Delta_P}$

- This is known as the hedge ratio
- For each asset, the investor should hold h put options and the value of their combined position does not change as the asset value changes

Picture credits:
Cover: Premier regard, Public domain, via Wikimedia Commons, https://commons.wikimedia.org/wiki/File:DALL-E_-_Financial_markets_(1).jpg
Back: Rhododendrites, CC BY-SA 4.0 https://creativecommons.org/licenses/by-sa/4.0, via Wikimedia Commons, https://upload.wikimedia.org/wikipedia/commons/0/04/Manhattan_at_night_south_of_Rockefeller_Center_panorama_(11263p).jpg

Andreas Krause
Department of Economics
University of Bath
Claverton Down
Bath BA2 7AY
United Kingdom

E-mail: mnsak@bath.ac.uk