Financial Mathematics

Introduction to
the Black-Scholes formula

0061-1. Price 30-day a European call option on a stock, using the Black-Scholes Option Pricing Formula.

Assume that the annual drift is 2%.
Assume that the annual volatility is 35%.
Assume that the annual force of interest is 1%.

(That is, \$1, invested risk-free, grows, after one year, to $e^{0.01}$ dollars.)

Assume that the current price is \$3 per share, and that the strike price is also \$3 per share.

0061-2. Let $C(r_*, \sigma_*, T, S, K)$ denote the Black-Scholes price on a T year European call option, struck at K, with current underlying price S, assuming the annual force of interest is r_*, and the annual volatility σ_*.

a. Compute

$$\Delta(r_*, \sigma_*, T, S, K) := \frac{\partial}{\partial S}[C(r_*, \sigma_*, T, S, K)].$$

b. Compute

$$\Theta(r_*, \sigma_*, T, S, K) := \frac{\partial}{\partial T}[C(r_*, \sigma_*, T, S, K)].$$

c. Compute

$$\rho(r_*, \sigma_*, T, S, K) := \frac{\partial}{\partial r_*}[C(r_*, \sigma_*, T, S, K)].$$