LISBON SCHOOL OF ECONOMICS & MANAGEMENT
UNIVERSIDADE DE LISBOA

# Corporate Investment Appraisal

## Masters in Finance

## 2015-2016

## Fall Semester

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## Problem Set 3: Valuation of Financial Options

1. The annual volatility of the return of company CJ's stock is 50%. Currently CJ's stock price is €4.25. The risk-free interest rate is 3% per annum (continuous).

(a) Compute the risk neutral probability of the scenario "up" in the context of the binomial model (1 year time step).

| | |
|---|---|
| u | 1.648721271 |
| d | 0.60653066 |
| p | 0.406762323 |

(b) What is the value of a European call option on a share of company CJ, with a strike price of €5.25 and time to maturity of 1 year? Use the binomial model.

| **Call** | |
|---|---|
| K | 5.25 |
| T | 1 |

**Stock Tree**

| Year | 0 | 1 |
|---|---|---|
| | 4.25 | 7.0070654 |
| | | 2.577755304 |

**Call Tree**

| Year | 0 | 1 |
|---|---|---|
| | 0.693585191 | 1.7570654 |
| | | 0 |

(c) Estimate the value of a put option on a share of company CJ, with expiry date in 3 years' time and an exercise price of €5.0.

| | |
|---|---|
| K | 5 |
| T | 3 |

| **Stock Tree** | Year | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|
| | | 4.25 | 7.0070654 | 11.55269777 | 19.04717855 |
| | | | 2.577755304 | 4.25 | 7.0070654 |
| | | | | 1.563487625 | 2.577755304 |
| | | | | | 0.948303181 |

| Put Tree | Year | 0 | 1 | 2 | 3 |
|---|---|---|---|---|---|
| | | 1.723817963 | 0.802819283 | 0 | 0 |
| | | | 2.443808705 | 1.394498028 | 0 |
| | | | | 3.288740043 | 2.422244696 |
| | | | | | 4.051696819 |

2. The shares of firm MC have an annual volatility of 40% and are currently priced at $4.0. There is no expectation of a dividend in the coming year. The riskless annual interest rate is 3% (continuous).

(a) What is the value (BS) of a call option on share of firm MC, for a maturity of 1 year and an exercise price of $6.0?

**Call**

| | | |
|---|---|---|
| T | 1 | year |
| K | 6 | |

**Using Black-Scholes**

| | |
|---|---|
| d1 | -0.73866277 |
| d2 | -1.13866277 |

| | |
|---|---|
| N(d1) | 0.230055899 |
| N(d2) | 0.127421918 |

| | |
|---|---|
| **Call** | 0.178287407 |

(b) What is the value (BS) of a European put option on a share of Firm MC, with expiry date in 8 months time, and with an exercise price of $6.0?

**Put**

| | |
|---|---|
| T | 0.67 |
| K | 6 |

| | |
|---|---|
| d1 | -1.016941719 |
| d2 | -1.343540352 |

| | |
|---|---|
| N(d1) | 0.154590578 |
| N(d2) | 0.089548535 |

| | |
|---|---|
| **Call** | 0.09 |
| **Put** | 1.97 |

3. Consider again the data of problem 1, regarding company CJ: The annual stock volatility is 50% and the stock price is currently €4.25. No dividend is expected for the coming year. The riskless annual interest rate is 3% (continuous).

   Re-compute the value of a call option with maturity of 1 year, with an exercise price of €5.25, based on the binomial model, considering intervals of four months (each branch is 4 months long).

| Stock | |
|---|---|
| Sigma | 0.5 |
| S | 4.25 |

| | |
|---|---|
| Rf | 3% |

| | | | | | |
|---|---|---|---|---|---|
| Number of intervals | | N | 3 | | |
| Time to maturity | | T | 1 | Dt | 0.33333333 Time Step |
| Strike Price | | K | 5.25 | | |
| u | 1.334658074 | | | | |
| d | 0.749255573 | | | | |

| | |
|---|---|
| p | 0.445496208 |

**Stock Tree**

| Month | 0 | 4 | 8 | 12 |
|---|---|---|---|---|
| | 4.25 | 5.672296814 | 7.57057674 | 10.10413137 |
| | | 3.184336186 | 4.25 | 5.672296814 |
| | | | 2.385881634 | 3.184336186 |
| | | | | 1.787635111 |

Call Tree

| Month | 0 | 4 | 8 | 12 |
|---|---|---|---|---|
| | 0.55180128 | 1.148816044 | 2.372815113 | 4.85413137 |
| | | 0.08215234 | 0.186259688 | 0.422296814 |
| | | | 0 | 0 |
| | | | | 0 |