Option Contracts

Moneyness and intrinsic value

- **In the money option**: Is an option that would provide a positive payoff if exercised

- **Out of the money option**: Is an option that would provide a negative payoff if exercised

- **At the money option**: Is an option that would breakeven payoff if exercised
Valuation of Options

Option Valuation Models

- Binomial model
- Black Scholes Merton Model (BSM)
Valuation of Options

Let the stock values for the up-move and down-move be $S_1^+$ and $S_1^-$ and for the call values, $C_1^+$ and $C_1^-$. 

One-Period Call Option with $X = $30

$\pi_U = 0.55$

$S_0 = $30$

$\pi_D = 0.45$

$S_1^+ = $30 \times 1.333 = $40.00$

$C_1^+ = \max(0, $40 - $30) = $10.00$

$S_1^- = $30 \times 0.750 = $22.50$

$C_1^- = \max(0, $22.50 - $30) = $0$

Today

1 year
We know the value of the option at expiration in each state is equal to max (0, stock price – exercise price):

\[ C^{++}_2 = \max(0, \$78.13 - \$45.00) = \$33.13 \]
\[ C^{++}_2 = \max(0, \$50.00 - \$45.00) = \$5.00 \]
\[ C^{+-}_2 = \max(0, \$50.00 - \$45.00) = \$5.00 \]
\[ C^{--}_2 = \max(0, \$32.00 - \$45.00) = \$0 \]
Valuation of Option Contracts

Now we know the value of the option in both the up-state \( C_1^+ \) and the down-state \( C_1^- \) one period from now. To get the value of the option today, we simply apply our methodology one more time. Therefore, bringing \( (C_1^+) \) and \( (C_1^-) \) back one more period to the present, the value of the call option today is:

\[
C_0 = \frac{(\pi_U \times C^+) + (\pi_D \times C^-)}{1 + R_f} = \frac{E(\text{call option value})}{1 + R_f}
\]

\[
= \frac{(0.6 \times $20.45) + (0.4 \times $2.80)}{1.07}
\]

\[
= $13.39 = $12.51
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