# Pre-Lecture Note

# Option - Definition

*Option is a financial agreement giving buyer (of the option) the right (but not the obligation) to buy/sell a specified amount of underlying asset at a specified price on or before a specified date*

- Compare it to a forward:

*A Financial Contract whereby the owner has the obligation to buy/sell a specified amount of underlying at a specified price on a specified date*

An option is a security, just like a stock or bond, and constitutes a binding contract with strictly defined terms and properties

# Call Option - Example

Say, you have bought a call option of strike 100 with a maturity of 1 month.

What this means is that at the end of month, whatever the price of underlying asset be, the buyer of the call option can BUY the underlying asset for $100.

Scenario 1: The price of the stock at the end of the month is $107.5

Scenario 2: The price of the stock at the end of the month is $97

# Put Option - Example

Say, you have bought a put option of strike 100 with a maturity of 1 month.

What this means is that at the end of month whatever the price underlying asset be, the buyer of the option can SELL the underlying asset for $100.

Scenario 1: The price of the stock at the end of the month is $107.5

Scenario 2: The price of the stock at the end of the month is $97

# Definitions

| | |
|---|---|
| Call Option | Gives buyer the right to BUY the underlying |
| Put Option | Gives buyer the right to SELL the underlying |
| Strike | Price of the underlying at which the option can be exercised |
| Expiry Date | The date at which the option can be exercised |
| Premium | Upfront payment made by the buyer to the seller (writer) of the option |

# Types of Options

| | CALL OPTION | PUT OPTION |
|---|---|---|
| BUYER | The **right** (but not the obligation) to buy | The **right** (but not the obligation) to sell |
| SELLER | The potential **obligation** to sell | The potential **obligation** to buy |

# Types of Options

**European Options** — Option only exercisable on expiry date

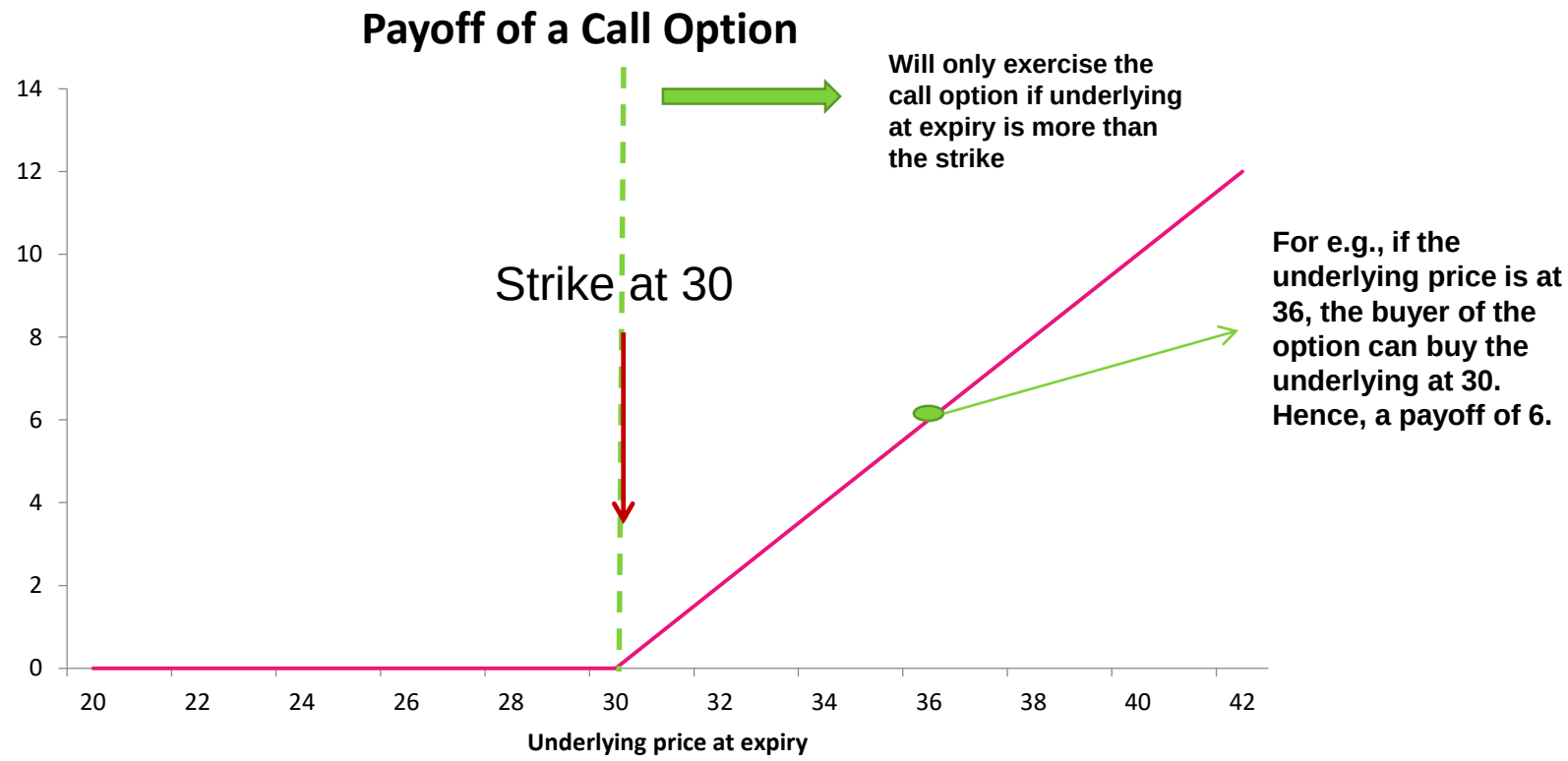
**American Options** — Option exercisable any time before or on expiry

**Bermudan Options** — Option exercisable on specific dates until expiry

# Payoffs – Call Option

Consider a Call Option on XYZ stock with strike = 30, expiry date = 30th April 201X.

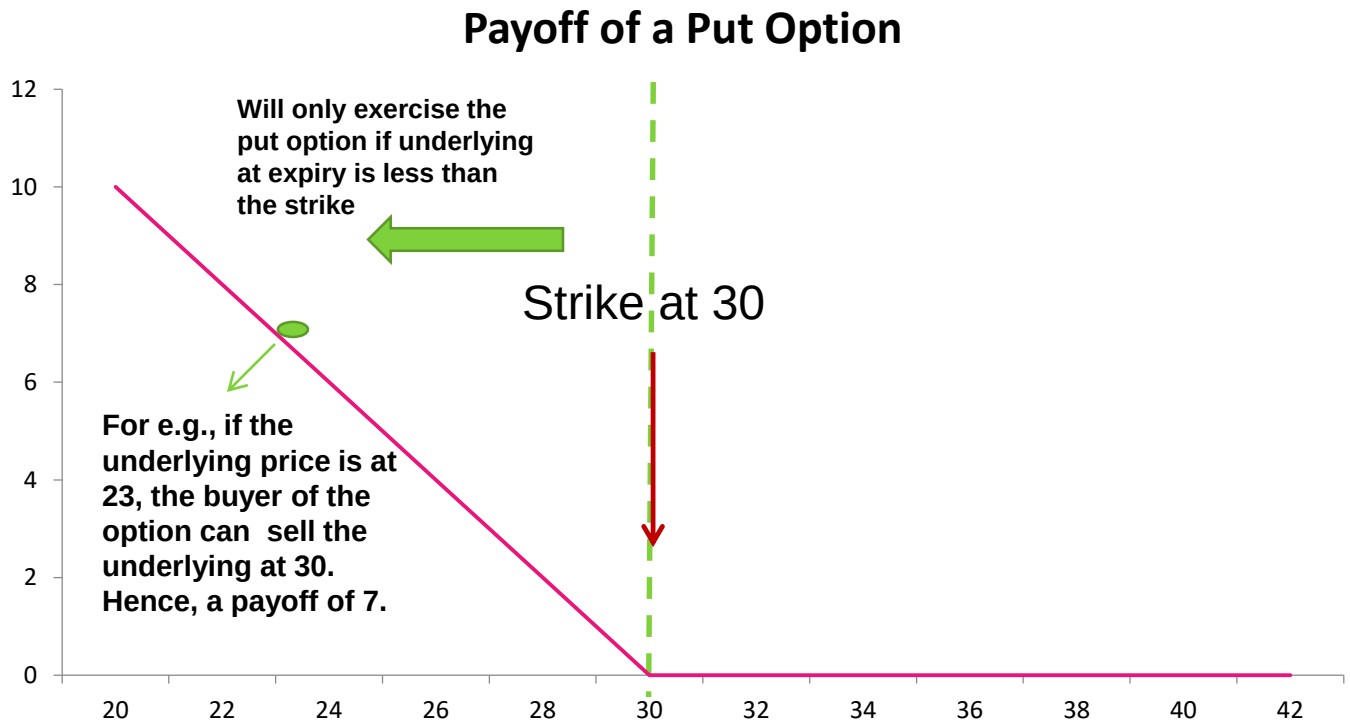
At Expiry, the payoff of the call option for the buyer is as shown below:



# Payoffs – Put Option

Consider a Put Option on XYZ stock with strike = 30, expiry date = 30th April 201X.

At Expiry, the payoff of the put option for the buyer is as shown below:



# Terminology : Moneyness

| Terminology | Call Option | Put Option |
|---|---|---|
| In the Money (ITM) | Underlying Price > Strike | Underlying Price < Strike |
| At the Money (ATM) | Underlying Price = Strike | Underlying Price = Strike |
| Out the Money (OTM) | Underlying Price < Strike | Underlying Price > Strike |

- If the underlying price used is the spot price, then ATM is at-the money-spot etc
- If the underlying price used is the future price, then ATM is at-the money-future etc

# Option Premium : Two Components

- **Intrinsic Value**
- **Time Value**

For Eg.,

If stock is at 100, and a Call option of strike 90 is priced at 12, then the price of the option can be broken down in 2 parts:

Call price = (100-90) + 2

**Intrinsic Value Time value**

# Intrinsic Value

- ***Intrinsic value*** *is the current worth of the option that depends on the option strike price and the current stock price as shown below:*
  - **For a call option, intrinsic value = stock price – strike**
  - **For a put option, intrinsic value = strike – stock price**
  - **Intrinsic value cannot be < zero**

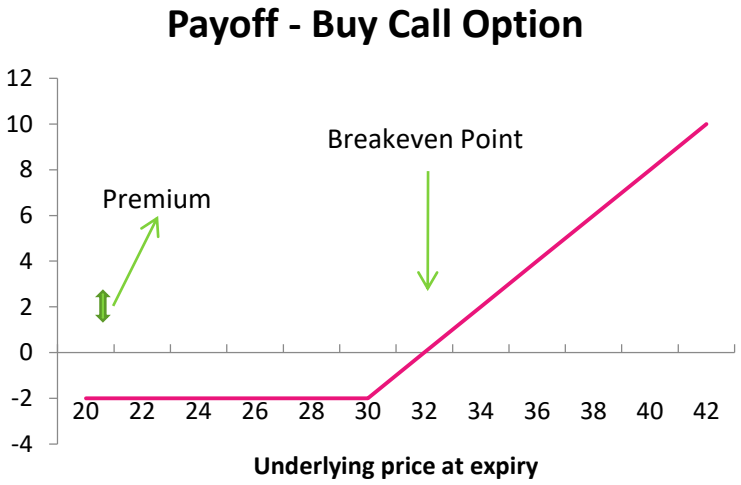
- ***More on Intrinsic value***
  - **An option with no intrinsic value is out-of-the-money**
  - **In the money options have intrinsic value**

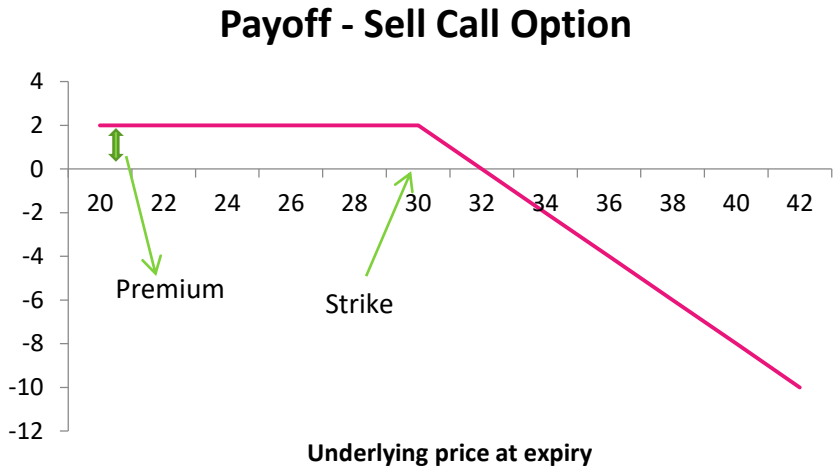
# Time Value

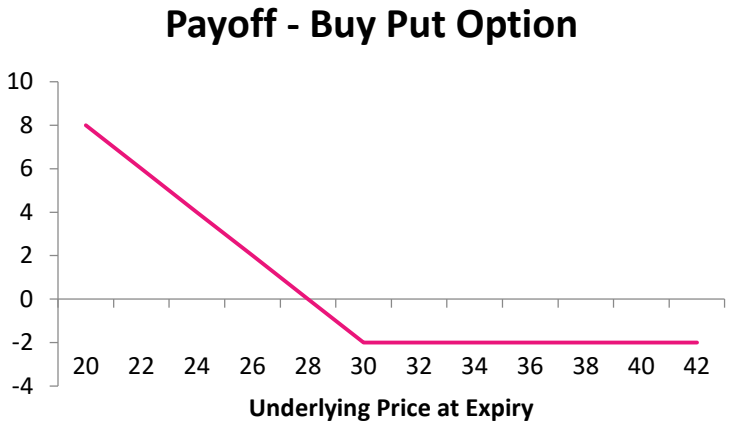
- **The chance or probability element in option premium. Even an option that is out-of-the-money (with zero intrinsic value) will have time value if it has any time remaining until expiry and assuming the share price can fluctuate. There is a chance that the option might move into the money before it expires.**

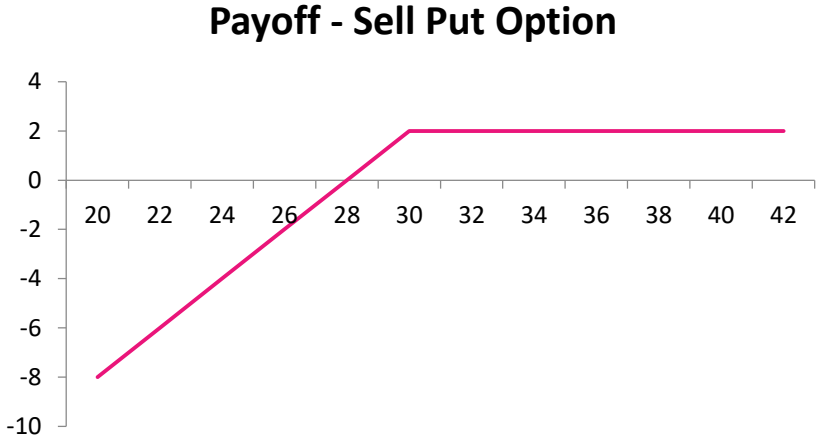
- **Premium of an Option = Intrinsic Value + Time Value**

# Revisiting payoffs



# Put-Call Parity

There is an important relation between call price, c, and put price, p.

Consider a portfolio A -

Portfolio A: One European call option of strike X plus an amount of cash X

What is the value of Portfolio A at expiry?

Scenario 1: The price of the stock at the end of the month is greater than X

Portfolio A's value -> $(S_T-X) + X = S_T$ ; $S_T$ is the stock price at expiry

Scenario 2: The price of the stock at the end of the month is less than X

Portfolio A's value -> 0 + X = X

**Therefore, portfolio A is worth max($S_T$,X)**

# Put-Call Parity

Consider a portfolio B –

Portfolio B: One European put option with strike X plus one share

What is the value of Portfolio B at expiry?

Scenario 1: The price of the stock at the end of the month is greater than X

Portfolio B's value -> $0 + S_T = S_T$

Scenario 2: The price of the stock at the end of the month is less than X

Portfolio B's value -> $(X-S_T) + S_T = X$

**Therefore, portfolio B is also worth $\max(S_T,X)$**

Therefore, both portfolios should have identical values today. This means

$$\mathbf{c + Xe^{-rt} = p + S_o}$$ where $e^{-rt}$ is the discounting factor