

Introduction to Options

BUSS386. Futures and Options

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Lecture Outline

- Introduction to Options
 - Terminology in option contracts
 - Payoff and profit

Type of Derivatives - Review

- Depending on contract types, there are different types of derivatives.
 - Futures
 - Forward
 - Swaps
 - :: Buyer of the contract has an **obligation** to trade.
 - Options
 - :: Buyer of the contract has a **right** to trade.

What Are Options?

Def. Option is a **contract** that gives an option-holder (or contract buyer) the **right to buy/sell** an asset in the future for a certain price.

- Comparison to forward
 - Option is similar to forward in that it is a contract to buy/sell an asset in the future.
 - A main difference is that the **buyer of option has the right** to buy/sell as opposed to the obligation in forward contract.
 - Thus, an option buyer can **choose** whether or not to exercise the contract.
 - In contrast, the **seller of option has the obligation** to follow what the buyer decides.

Options - Terminology

- Strike (or exercise) price: the promised price to trade.
- Expiration (or maturity) date: the last date that option can be exercised.
- Option price (or option premium): the price to buy the option contract
- Call vs. Put options
 - ① Call option: Holder has the right to **buy** the underlying asset for a fixed price.
 - ② Put option: Holder has the right to **sell** the underlying asset for a fixed price.

Options - Terminology

- European v.s. American options
 - ① European option: Option can be exercised **only on the expiration date**.
 - ② American option: Option can be exercised **at any time up to the expiration date**.
 - Long v.s. Short positions
 - ① Long position: to buy an option (paying the option price)
 - A buyer has the right to exercise the contract.
 - ② Short position: to sell an option (receiving the option price)
 - A seller needs to follow what the buyer decides.
- e.g. Long position of June European call option on Microsoft stock with a strike price of \$95.

Options - Example

Options on Microsoft stock with the expiration date of 19 February 2021

Calls for February 19, 2021

Contract Name	Last Trade Date	Strike	Last Price	Bid	Ask	Change	% Change	Volume	Open Interest	Implied Volatility
MSFT210219C00185000	2020-10-09 3:28PM EDT	185.00	36.86	36.85	37.55	+4.86	+15.19%	7	165	37.85%
MSFT210219C00190000	2020-10-09 1:42PM EDT	190.00	32.48	33.20	33.85	+3.30	+11.31%	42	133	37.28%
MSFT210219C00195000	2020-10-09 2:39PM EDT	195.00	29.15	29.75	30.25	+2.95	+11.26%	10	84	36.54%
MSFT210219C00200000	2020-10-09 2:14PM EDT	200.00	26.17	26.50	26.95	+2.27	+9.50%	7	383	36.06%
MSFT210219C00205000	2020-10-09 2:24PM EDT	205.00	23.10	23.45	23.95	+2.30	+11.06%	35	787	35.79%
MSFT210219C00210000	2020-10-09 3:57PM EDT	210.00	20.74	20.65	21.20	+2.39	+13.02%	75	1,621	35.59%
MSFT210219C00215000	2020-10-09 3:58PM EDT	215.00	18.32	18.10	18.60	+2.42	+15.22%	192	8,760	35.26%
MSFT210219C00220000	2020-10-09 3:30PM EDT	220.00	15.75	15.70	16.00	+1.45	+10.14%	69	947	34.52%
MSFT210219C00225000	2020-10-09 3:59PM EDT	225.00	13.85	13.65	14.05	+1.90	+15.90%	12	974	34.63%
MSFT210219C00230000	2020-10-09 3:35PM EDT	230.00	11.70	11.70	12.15	+1.48	+14.48%	106	1,453	34.44%
MSFT210219C00235000	2020-10-09 1:11PM EDT	235.00	10.00	10.05	10.40	+1.00	+11.11%	7	1,257	34.15%
MSFT210219C00240000	2020-10-09 3:54PM EDT	240.00	8.67	8.50	8.80	+1.22	+16.38%	118	1,578	33.78%
MSFT210219C00245000	2020-10-09 3:15PM EDT	245.00	7.25	7.20	7.55	+0.65	+9.85%	29	3,109	33.78%
MSFT210219C00250000	2020-10-09 3:28PM EDT	250.00	6.23	6.10	6.30	+0.68	+12.25%	71	1,399	33.41%
MSFT210219C00255000	2020-10-09 3:17PM EDT	255.00	5.30	5.15	5.45	+0.63	+13.49%	12	5,358	33.66%
MSFT210219C00260000	2020-10-09 1:49PM EDT	260.00	4.38	4.35	4.50	+0.38	+9.50%	14	764	33.32%
MSFT210219C00265000	2020-10-09 1:49PM EDT	265.00	3.73	3.65	3.90	+0.23	+6.57%	23	873	33.62%

[source: Yahoo finance]

Investment Using Options

- Suppose that we buy a February Microsoft call option with strike price of 220.
- Today, we pay the option price, \$15.75.
- On 19 February, the option payoff depends on the stock price then.
 - ① What if stock price becomes 250?
 - Using the option, we can buy the stock for 220, when its market value is 250.
 - Exercise the option!
 - Option payoff = $250 - 220 = 30$.
 - Profit including initial cost = $30 - 15.75 = 14.25$ (Ignoring time value of money)

Common types of exchange-traded options

- Stock options
 - Exchanges: CBOE, AMEX, PHLX, ISE (Nasdaq) etc.
 - Over 1000 different stocks
- Index options
 - DJ Industrial, S&P100, S&P500, Nasdaq 100, Russell 2000, etc.
- Foreign currency options (traded mainly on PHLX)
- Options on futures
 - Interest rates, agricultural, oil, livestock, metals, currencies, cryptocurrencies, and stock indices
 - Typically traded on same exchange as underlying futures contracts
- As for futures, exchange-traded options require margin to ensure performance

Investment Using Options

② What if stock price becomes 200?

- Through the option contract, we buy the stock for 220, but its market value is only 200.
- Do not exercise the option.
- Option payoff = 0.
- Profit including initial cost = $0 - 15.75 = -15.75$ (Ignoring time value of money)
- Option holders have the **right** to buy or sell the underlying asset. So they exercise the option only when the exercise results in a positive payoff.

Investment Using Options - Example

- Suppose that we buy a February Microsoft put option with strike price of 195. Its option price is \$9.75.

Q1. If stock price on the expiration date is 210, would you exercise? What is profit?

Q2. If stock price on the expiration date is 180, would you exercise? What is profit?

Option Payoff and Profit - General Result

- Consider a European call option with expiration date T and strike price K .
- The option payoff for a long position will depend on the future stock price S_T on the expiration date:

$$\begin{cases} \text{If } S_T \geq K, & S_T - K \\ \text{If } S_T < K, & 0 \end{cases}$$

- In short, the payoff for the long position in a European call is

$$\max(S_T - K, 0)$$

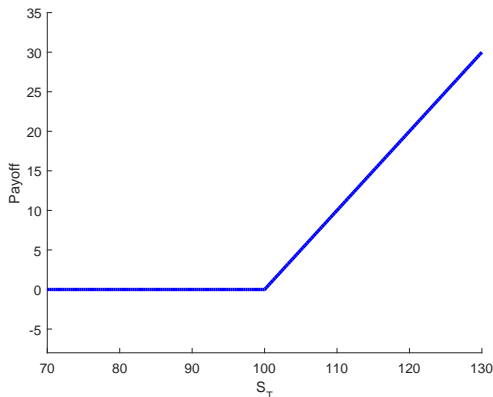
- The option profit is a gain/loss considering the initial cost:

$$\text{profit} = \text{payoff} - \text{option price}.$$

Option Payoff and Profit

e.g. Suppose that an investor buys a European call option on Microsoft shares with a strike price of \$100. The price of an option is \$5.

Payoff to a long position in the call

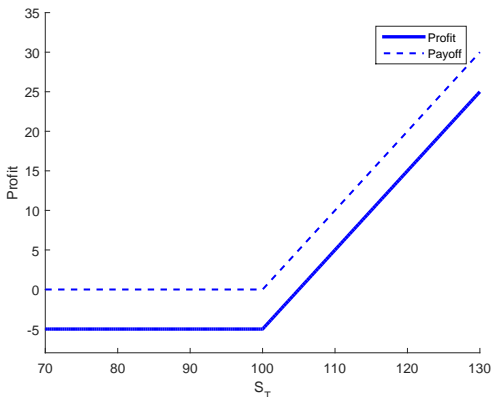


$$\text{Payoff} = \max(S_T - 100, 0)$$

Option Payoff and Profit

e.g. Suppose that an investor buys a European call option on Microsoft shares with a strike price of \$100. The price of an option is \$5.

Profit to a long position in the call



$$\text{Profit} = \max(S_T - 100, 0) - 5$$

Option Payoff and Profit

- Consider a European put option with expiration date T and strike price K .
- The option payoff for the long position will depend on the future stock price S_T on the expiration date:

$$\begin{cases} \text{If } S_T \geq K, & 0 \\ \text{If } S_T < K, & K - S_T \end{cases}$$

- In short, the payoff for the long position in a European put option is

$$\max(K - S_T, 0)$$

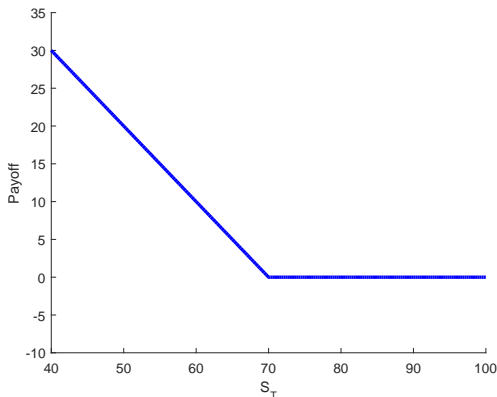
- The option profit is a gain/loss considering the initial cost:

$$\text{profit} = \text{payoff} - \text{option price}.$$

Option Payoff and Profit

- e.g Suppose that an investor buys a European put option with a strike price of \$70 to sell IBM shares. The price of an option is \$7.

Payoff to a long position in the put option.

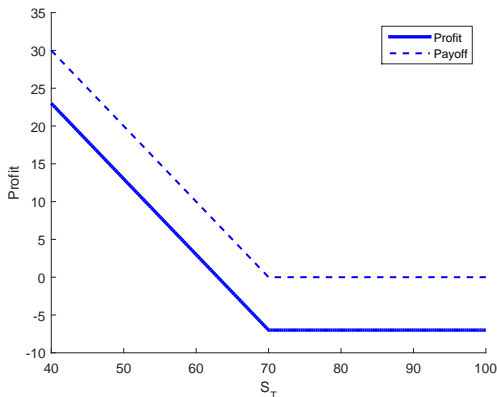


$$\text{Payoff} = \max(70 - S_T, 0)$$

Option Payoff and Profit

- e.g Suppose that an investor buys a European put option with a strike price of \$70 to sell IBM shares. The price of an option is \$7.

Profit to a long position in the put option.



$$\text{Profit} = \max(70 - S_T, 0) - 7$$

Option Payoff and Profit

- We have looked at payoffs and profits for long positions in call/put options.
- Note that in profit diagrams, it is standard not to adjust for the time value of the upfront premium payment.
- The payoff for the short position is the opposite of long position.
- Payoff for the short position in a call option

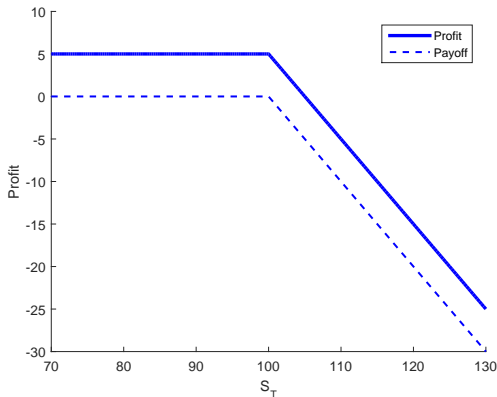
$$- \max(S_T - K, 0) = \min(K - S_T, 0)$$

- Payoff for the short position in a put option

$$- \max(K - S_T, 0) = \min(S_T - K, 0)$$

Option Payoff and Profit

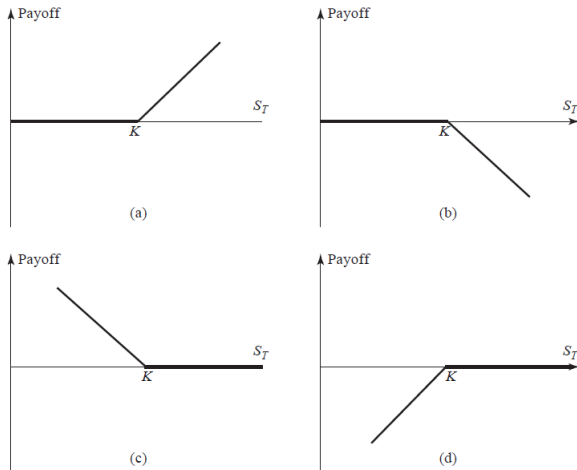
e.g Go back to the previous Microsoft call option with a strike price of \$100 and the option price of \$5. Payoff and profit to the option seller is as follows:



$$\text{Profit} = -\max(S_T - 100, 0) + 5$$

Summary of Option Payoff

Figure 9.5 Payoffs from positions in European options: (a) long call; (b) short call; (c) long put; (d) short put. Strike price = K ; price of asset at maturity = S_T .



More on Option Terminology

- In the money / At the money/ Out of the money
 - Options are referred to as in the money (out of the money), when they give positive (negative) payoff if exercised now.
 - They are at the money, when they give zero payoff if exercised now.

	call	put
$S_t > K$	in the money	out of the money
$S_t < K$	out of the money	in the money

- Intrinsic value
 - = the maximum of zero and the payoff if options are exercised immediately.
 - Intrinsic value of call option = $\max(S_t - K, 0)$
 - Intrinsic value of put option = $\max(K - S_t, 0)$

Exotic Options

- Asian Options
 - Payoffs depend on the average price of the underlying asset during at least some portion of the life of the option.
- Barrier Options
 - Payoffs depend on depend not only on some asset price at option expiration, but also on whether the underlying asset price has crossed through some “barrier.”
- Lookback Options
 - Payoffs depend in part on the minimum or maximum price of the underlying asset during the life of the option.
- Digital Options
 - Fixed payoffs that depend on whether a condition is satisfied by the price of the underlying asset.