Computational Methods for Finance
Week 1: Introduction to option I

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September 2023

Learning Outcomes

At the end of this lecture you will be able to

- Describe the financial market and its components.
- Understand the basic features and terminology associated with options
- Calculate the payoffs of the call and put options

Financial Markets

Definition 1

Financial markets: 'A market is the place where traders gather to trade instruments.' – Harris (2003)

- 'The place': Trading venues: e.g. Physical trading foors and Electronic trading systems
- 'Traders': Market participants: e.g. Investors, Hedgers, Market Makers, and Brokers
- 'Instruments': Securities: e.g. Equities, Bonds, Derivatives and FX

Financial Markets – Trading Venues

- Classification:
  According to Order Execution System:

Order-driven Market (Limit Order/Auction Market)	Agents submit orders which then are matched directly by trading platform	LSE (SETS), Euronext, TSE
Quote-driven Market (Dealer Market)	Contracts are fulfilled through intermediaries	LSE (SEAQ)
Hybrid	Combining order- and quote-driven features	NYSE

Financial Markets: Trading Venues

According to the Degree of Automation:

- Physical Trading Floors

(a) NYSE trading floor 1932 v.s. 2007

(b) CME trading floor early 1997

Financial Markets: Trading Venues

- Electronic Trading Systems

(a) Equinix data warehouse

(b) Inside of Equinix data warehouse

Financial Markets: Trading Venues

- Electronic trading systems

Figure 3: Euronext Office

Examples

Primary Exchanges:	LSE(SETS), NYSE, NASDAQ, TSX
New Entrants (Multilateral Trading Facilities):	BATS, Chi-X, Turquoise

Financial Markets: Market paticipants

TRADER TYPE	GENERIC EXAMPLES	WHY THEY TRADE	TYPICAL INSTRUMENTS
Investors	Individuals Corporate pension funds Insurance funds Charitable and legal trusts Endowments Mutual funds Money managers	To move wealth from the present to the future for themselves or for their clients	Stocks Bonds
Borrowers	Homeowners Students Corporations	To move wealth from the future to the present	Mortgages Bonds Notes
Hedgers	Farmers Manufacturers Miners Shippers Financial institutions	To reduce business operating risk	Futures contracts Forward contracts Swaps
Asset exchangers	International corporations Manufacturers Travelers	To acquire an asset that they value more than the asset that they tender	Currencies Commodities
Gamblers	Individuals	To entertain themselves	Various

Figure 4: Buyside Traders

Financial Markets: Market paticipants

TRADER TYPE	GENERIC EXAMPLES	WELL-KNOWN U.S. EXAMPLES	WHY THEY TRADE
Dealers	Market makers Specialists Floor traders Locals Day traders Scalpers	Spear Leads & Kellogg LaBranche & Co. Bernard L. Madoff Investment Securities Knight Trading Group TimberHill LLC	To earn trading profits by supplying liquidity
Brokers	Retail brokers Discount brokers Full-service brokers Institutional brokers Block brokers Futures commission merchants	Charles Schwab & Co. E*Trade Dreyfus Brokerage Services Abel/Noser Corp. XpressTrade Cargill Financial Markets Group	To earn commissions by arranging trades for clients
Broker-dealers	Wirehouses	Goldman Sachs Merrill Lynch Salomon Smith Barney Morgan Stanley Dean Witter Credit Suisse First Boston	To earn trading profits and trading commissions

Figure 5: Sellside Traders

Buy and Sell sides

AAPL				Orders Accepted	Total Volume
APPLE INC COM				197,049	1,361,499
	Market Depth	TOP OF BOOK		LAST 10 TRADES	
	Shares	Price	Time	Price	Shares
ASKS	200	211.79	14:12:43	211.75	100
	200	211.78	14:12:42	211.75	10
	300	211.77	14:12:42	211.75	100
	300	211.76	14:12:42	211.75	100
	200	211.75	14:12:42	211.77	16
BIDS	200	211.72	14:12:42	211.76	100
	100	211.71	14:12:35	211.77	5
	100	211.70	14:12:30	211.75	100
	300	211.68	14:12:29	211.74	100
	200	211.67	14:12:27	211.73	100

Bid-Ask Spread

Figure 6: Bid and Ask prices

Financial Market: Instruments

CLASS	INSTRUMENT	CREATORS
Real assets	Spot commodities	Farmers, miners, manufacturers
	Intellectual properties	Inventors and artists
	Real estate	Builders
	Pollution emission rights	Governments
Financial assets	Stocks and warrants	Corporate issuers
	Bonds	Corporate issuers, governments
	Trust units	Trusts
	Currencies	Governments, banks
Derivative contracts	Futures contracts	Sellers
	Forward contracts	Sellers
	Options	Sellers
	Swaps	Sellers
Insurance contracts	Insurance policies	Corporations
	Reinsurance contracts	Corporations
Hybrid instruments	Warrants	Corporate issuers
	Index linked bonds	Corporate issuers
	Convertible bonds	Corporate issuers
Gambling contracts	Numerous types	Individuals
		Bookies
		Casinos
		Racetracks

Figure 7: Trading Instruments

Derivatives and option

Definition 2

A Derivative Security (also known as a contingent claim) is a security whose value is contingent (dependent) on the value of another (more basic) underlying asset.

Definition 3

A European Call (Put) Option gives the owner the right to buy (sell) a given number of a specified underlying asset at a specified price (i.e. exercise or strike price) at the expiration date (i.e. at maturity).

Definition 4

American options can be exercised at any time up to the expiration date, whereas European options can be exercised only on the expiration date itself.

Option payoffs

Payoffs:

Option type	Payoffs
Long Call	$max(S_T - K, 0)$
Short Call	$-max(S_T - K, 0) = min(K - S_T, 0)$
Long Put	$max(K - S_T, 0)$
Short Put	$-max(K - S_T, 0) = min(S_T - K, 0)$

S_T : The spot price (of the underlying asset) at the maturity of the contract.
K: the (pre-specified) strike price.

Option payoffs

Payoffs:

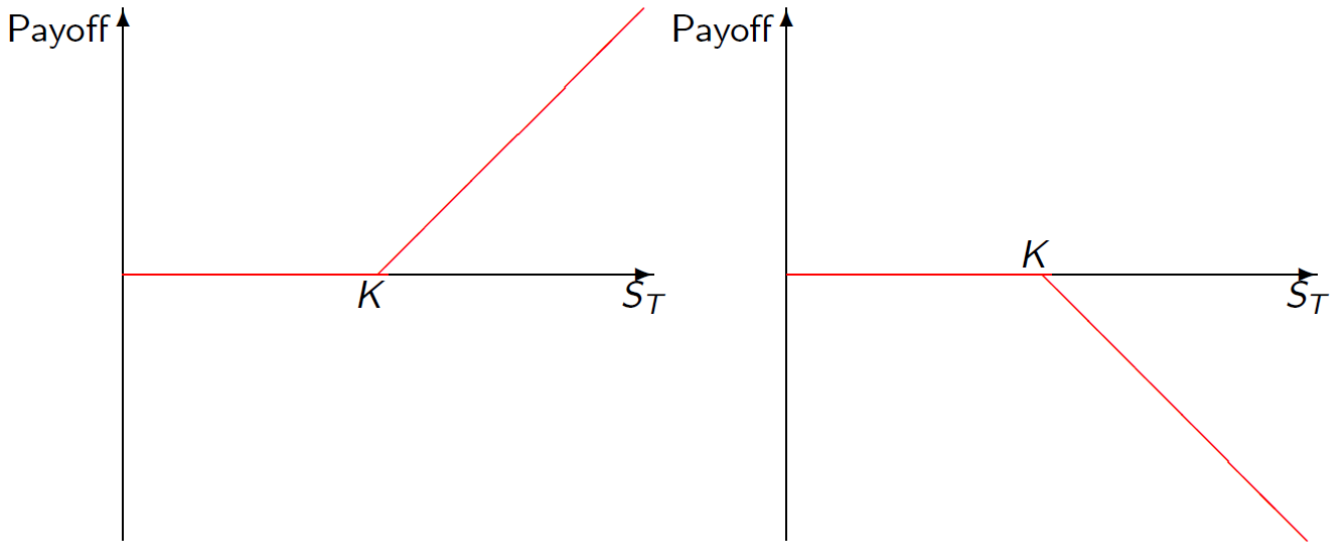

Figure 8: Call option payoffs

Option payoffs

Payoffs:

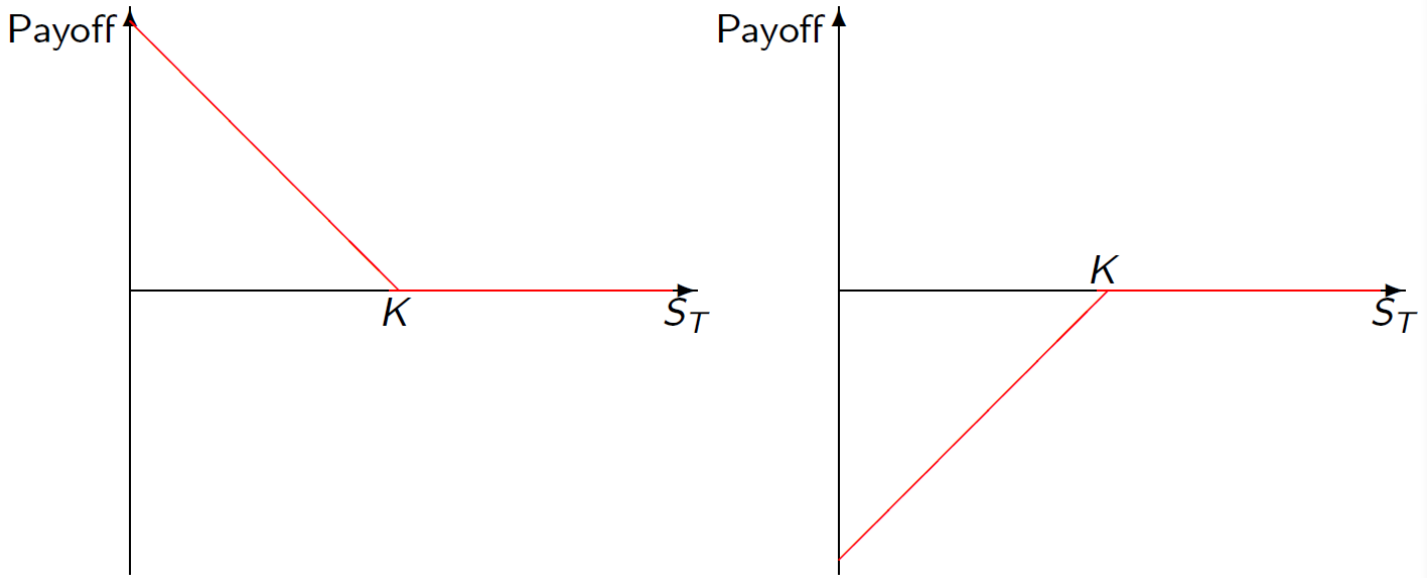

Figure 9: Put option payoffs

Specifics

- Underlying Assets
  - Stocks
  - Foreign Currency
  - Stock Indices
  - Futures
- Contract Specifics (stock option)
  - Expiration Dates
  - Strike Prices
  - European or American Styles
  - Call or Put option classes

Moneyness and Value

- Moneyness

	Calls	Puts
In-the-money	$S > K$	$S < K$
At-the-money	$S \approx K$	$S \approx K$
Out-of-the-money	$S < K$	$S > K$

- Value
  - Intrinsic Value of a Call $= max(0, S - K)$
  - Intrinsic Value of a Put $= max(0, K - S)$

Reading

- Part I, Harris (2003) Trading and Exchanges: Market Microstructure for Practitioners
- Chapter 10, Hull (2015)