

# Financial Mathematics

MATH 5870/6870<sup>1</sup>  
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<sup>1</sup>Based on Robert L. McDonald's *Derivatives Markets*, 3rd Ed, Pearson, 2013.

# Chapter 1. Introduction to Derivatives

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§ 1.1 What is a derivative?

§ 1.2 An overview of financial markets

§ 1.3 The use of derivatives

§ 1.4 Buying and short-selling financial assets

§ 1.5 Problems

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## Transaction costs and the bid-ask spread

**Definition 1.4-1** The price at which one can buy is called the **offer price** or **ask price**, and the price at which one can sell is called the **bid price**. The difference between the ask price and the bid price is called the **bid-ask spread**.

Terminology is in the perspective  
of market-maker

	Ask (offer) price	Bid price
End users	Buy	Sell
Market makers	Sell	Buy

## Transaction costs

Commission	bid-ask spread
Brokers	Market-makers
Electronic trading system	
Fixed amount per transaction or percentage of purchase price	Based on per share

Example 1.4-1 Buy and sell 100 shares of XYZ with

bid = \$49.75, offer = \$50, commission = \$15.

What is the transaction cost?

Solution.

1. Buy

$$100 \times \$50 + \$15 = \$5,015$$

2. Sell

$$100 \times \$49.75 - \$15 = \$4,960$$

3. Transaction cost

$$\$5,015 - \$4,960 = \$55$$

(Note that We have payed twice the commission.)



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## Ways to buy or sell

	Market order	Limited order
Pros	Filled immediately	Might not be filled
Cons	Price could be better	At a better price

1. **Market order**: an instruction to trade a specific quantity of the asset immediately, at the best price that is currently available.
2. **Limited order**: an instruction to trade a specific quantity of the asset at a specified price.
3. Others such as **stop-loss order**.

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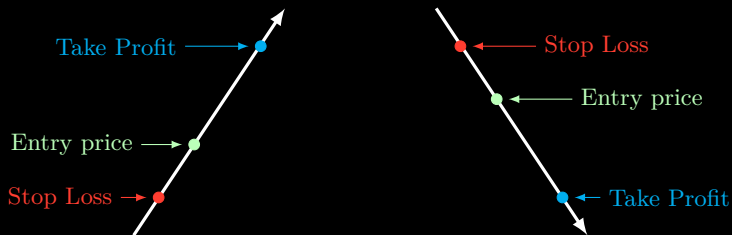
# Long vs short positions

Buy when you expect  
the price will go up

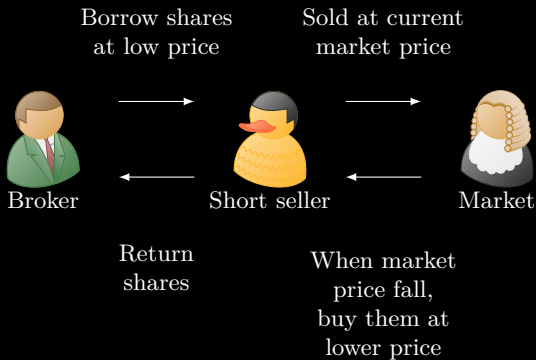
Sell when you expect  
the price will go down

Long=Buy

Short=Sell



# Short-selling



Example 1.4-2 Short-sell IBM stock for 90 days.

	Day zero	Dividend Ex-Day	Day 90	Profit
Action	Borrow shares		Return shares	
Security	Shell shares		Purchase shares	
Cash flow	$+S_0$	$-D$	$-S_{90}$	$S_0 - D - S_{90}$



## Three reasons to short-sell

1. Speculation
  2. Financing
  3. Hedging
- 

## Credit risk in short-selling

- ▶ The lender holding the money with an extra called Haircut.

## Interest received from lender

- ▶ Scarcity decreases the interest rate.
- ▶ Repo rate in bond markets.
- ▶ Short rebate in the stock market.

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