ACUT 471 - Chapter1: Introduction to Derivatives

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- A derivative contract, is a financial contract between two counterparties whose value is a function of—*derives from*—the value of another variable, for example the price of a stock, stock index or commodity.
- Note that definition of a derivative contract has nothing to do with calculus or differentiation.
- Examples: forward, futures, option and swap contracts (these contracts will be studied in the coming chapters the of this course).

- The *long position* is the counterparty who agrees to *buy* the asset.
- The *short position* is the counterparty who agrees to *sell* the asset.

- The price at which you can *buy* is called the *offer price or ask price*.
- The price at which you can *sell* is called the *bid* price.
- The *difference* between the price at which you can buy and the price at which you can sell is called the *bid-ask spread*.

Suppose XYZ is bid at \$49.75 and offered at \$50, and the commission is \$15.

- If you buy 100 shares of the stock you pay ...
- If you immediately sell them again, you receive ...
- Your *round-trip transaction cost*—the difference between what you pay and what you receive from a sale, is ...

Note that the transaction cost can be broken down into two parts: ..... and ....

Suppose XYZ is bid at \$49.75 and offered at \$50, and the commission is 0.3%.

- If you buy 100 shares of the stock you pay ...
- If you immediately sell them again, you receive ...
- Your round-trip transaction cost is ...

Here we will discover some assumptions in the financial market, which be used in our study of this course.
Let assume that the current price of a stock is denoted by S_0 and the future price is donated by S_1.

Assumption 1 (Randomness)

The future stock price is a random variable with at least two different values. However, the future price of the risk-free security (for example a bond) is a known number.

Assumption 2 (Positivity of Prices)

All stock and bond prices are strictly positive,

Assumption 3 (Divisibility, Liquidity and Short Selling)
An investor may hold any number x and y of stock shares and bonds, whether integer or fractional, negative, positive or zero.

In general $x, y \in \mathbb{R}$.

Assumption 4 (Solvency)

The wealth of an investor must be non-negative at all times

$$V(t) \geq 0 \quad \forall t$$

A portfolio satisfying this condition is called *admissible*.

Assumption 5 (Discrete Unit Prices)

The future price of a share is a random variable taking only finitely many values.

Assumption 6 (No-Arbitrage Principle)

There is no admissible portfolio with initial value $V_0 = 0$ such that its future value satisfies $V_1 > 0$ with non-zero probability.

In other words, if the initial value of an admissible portfolio is zero, $V_0 = 0$, then $V_1 = 0$ with probability 1.

A short-sale of XYZ entails borrowing of XYZ shares from an owner, and then selling them, receiving the cash.
Some time later, you buy back the XYZ stock, and return it to the lender.

Suppose you short-sell 300 shares of XYZ stock, which has a bid price of \$25.12 and ask price of \$25.34. You cover the short position 6 month later when the bid price is \$23.19 and the ask price is \$22.91.
What profit do you earn in the short-sales (the commission is 0.3%)