LECTURE 4
Chapter 3

BASIC NOTATIONS AND TERMINOLOGY:

S_0 = Stock price today, S_T= Stock price at expiration

X=Exercise Price (Future price)

T=time to expiration (sometimes use n)

C= Call option price or premium paid/received for the call option

P= Put option price or premium paid/received for the put option

Payoff & Profits

S-X= Call Option Payoff (if negative the payoff is $0) – [Profit = Payoff – Call Premium]

X-S= Put Option Payoff (if negative the payoff is $0) – [Profit = Payoff – Put Option]

OPTION VALUATION

INTRINSIC & TIME VALUES

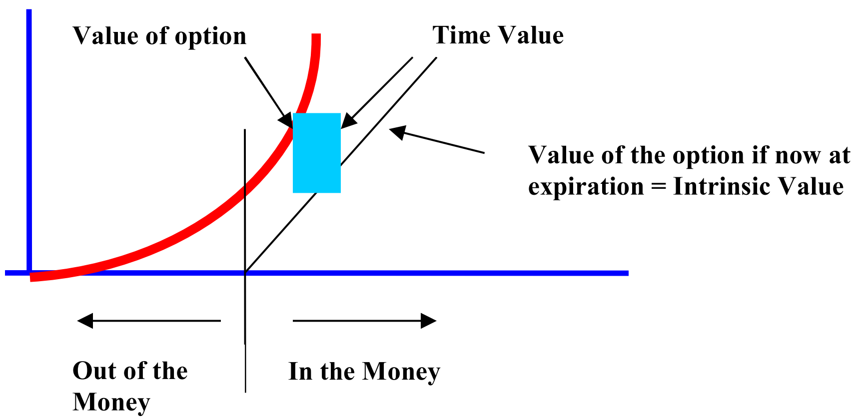
Consider a CALL option that is out of the money at the moment – which is stock below the exercise price – This does not mean that the value is Valueless.

There is always a chance that the stock will increase sufficiently by expiration date (or Zero value at Expiration day)

S – X = Intrinsic value

The difference between the Actual Call price and the value of the Intrinsic Value call Time Value of the option – It is the Volatility Value If not exercised the payoff cannot be less than Zero – As the price of the stock increases, the probability to be exercised is higher as it approaches the "adjusted" intrinsic value.

S – PV (x)



Principals of Call Option Pricing

It is important to keep in mind that our objective is to determine the price of a call option prior to its expiration day.

The minimum value of an option is called intrinsic value, sometimes refer to as parity value or exercise value. Intrinsic value is positive for in-the-money calls and zero for out-of-the money calls (not exercisable). Therefore, intrinsic value is the value the call holder receives from exercising the option and the value the call writer gives up when the option is exercised.

Example:

DCRB OPTION DATA MAY 14

	CALLS			PUTS			Intrinsic Value
Exercise Price	May	June	July	May	June	July	
120	8.75	15.40	12.90	2.75	9.25	13.65	5.94
125	5.75	13.50	18.60	4.60	11.50	16.60	0.94
130	3.60	11.35	16.40	7.35	14.25	19.65	-

Risk Free Rates	0.0447	0.0446	0.0453	0.0447	0.0446	0.0453
Current Stock Price	**125.94**					

To prove the intrinsic value rule, consider the DCRB June 120 call. The stock is \$125.94, the exercise price is \$120 – The option is in-the-money. Evaluating the expression gives Max (0, \$125.94) = \$5.94– basically one sided. Now considered what would happen if the call were priced at less than \$5.94 – say \$3.00. An option trader could buy the CALL for \$3, exercise it – which would entail purchasing the stock at \$120 – then sell the stock at \$125.94 – the arbitrage transaction would net an immediate risk-less (mispriced) profit of \$2.94 on each share – If everyone do this the investors will eventually drive the option price to \$5.94 - minimum level – zero profit.

In later lectures we will learn to measure the intrinsic value (S-X) in order to calculate the fair value of the premium – basically valuing "the bet".

DETERMINING OF OPTION VALUE

Six factors that **affect** the value of Call option:

If the Value Increases		**The Value of the Call Option**
1. Stock Price	S	Increase
2. Exercise Price	X	Decrease
3. Volatility op the stock price	Σ	Increase
4. The time to expiration	T	Increase
5. The interest rate	Rf	Increase
56. Dividend Value of the stock	D	Decrease

INTEREST RATE IMPACT

- Interest rates effect the lower bound
- Interest rates increase, calls are more attractive to byers, so they will have higher prices

VOLATILITY IMPACT AND ONE S IDED VOLATILITY COCEPT

Example of one-sided volatility:
Value \$10 and \$50 = average \$30
Value \$20 and \$40 = average \$30

Both have the same average, but the volatility on the first one is much higher. Suppose the exercise price is \$30…. Option Payoff? With 1 in 5 probabilities 0.2.

High Volatility Scenario

Stock Price	10	20	30	40	50
Option Payoff	0	0	0	10	20

Low Volatility Scenario

Stock Price	20	25	30	35	40
Option Payoff	0	0	0	5	10

High Volatility Average = (0+0+0+10+20)/5 = 6
Low Volatility Average = (0+0+0+5+10)/5 = 3

So it doesn't matter if its below $30 (Zero value) – upside only volatility.

Effect of Stock Volatility

One of the basic principles of investor behavior is that individuals prefer less risk to more. For holders of stocks, higher risk means lower value. Higher risk in a stock, however, translates into greater value for a call option on it This is because greater volatility increases the gains on the call if the stock price increases because the stock price can then exceed the exercise price by a larger amount. On the other hand, greater volatility means that if the stock price goes down, it can be much lower than the exercise price. To a call holder, however, this does not matter because the potential loss is limited; it is said to be truncated at the exercise price.

Example:
Consider the DCRB July 125 call. Suppose the stock price is equally likely to be at 110, 120, 130 or 140 at expiration. The call, then, is equally likely to be worth 0, 0, 5 and 15 at expiration. Now suppose the stock volatility increases so that it has an equal chance of being at 100, 120, 130 or 150. From a stockholder's point of view, the stock is far riskier which is less desirable. From the option holder's perspective, the equally possible option prices at expiration are 0, 0, 5 and 25, which is more desirable. In fact, the option holder will not care how low the stock can go. If the possibility of lower stock prices is accompanied by the possibility of higher stock prices, the option holder will benefit and the option will be priced higher when the volatility is higher – one-sided volatility.

Put Call Parity Concepts (discussed later in detail)

The calculated fair value of the bet or the premium someone is willing to pay up front to buy the option to exercise a set price in the future has the view that the underline asset will go up. The person has the view that the underline asset will go down and is willing to pay a premium to exercise the option to sell (put option purchaser) – such premium should be in parity with the purchaser of the call option. The basic formula (discussed later) is **C-P = S – PV(x)**