



# CHAPTER 9

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## INTRODUCTION TO OPTION MARKETS

# TODAY

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Provide an overview of option contracts and markets:

- Terminology
- Option payoffs
- Option value
- OTC options
- Margin requirements

# WHAT IS AN OPTION?

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- Contract giving owner the right to buy (call) or sell (put) a **specific quantity** of a **specific asset** at a **specific price** by a **specific date**:
  - All terminology from forwards apply to options except for a **specific price**, which is called the **strike price** or **exercise price**,  $K$
- To buy or sell asset at  $K$  is called ***exercising the option***:
  - **American Options** - can exercise any time
  - **European Options** - can exercise only at expiration

Note: Only option buyers have rights. Option writers have ***obligations*** if buyer decides to exercise.

# EXCHANGE-TRADED OPTIONS

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- Underlying assets
  - Stocks
  - Foreign currencies
  - Stock indices
  - Futures

# EXCHANGE TRADED OPTIONS

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- Stock options
  - Traded on CBOE, NASDAQ OMX, NYSE Euronext, etc.
  - The underlying asset is the individual stock
  - 100 shares per contract
- Index options
  - S&P 500 options, European options
  - S&P 100 options, American options
  - Long-term options (3-5 year options)
    - S&P 500 LEAPS
  - 100 x index level

# EXCHANGE TRADED OPTIONS

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- Currency options (traded on PHLX)
  - Often European
- Futures options
  - The underlying asset is a futures contract
  - Matures just before the delivery period

# SPECIFICATION OF STOCK OPTIONS

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- Expiration dates
- Expiration month: Jan., Feb., ..., Dec.
  - Some stocks have weekly option maturities available too
- 11:00 p.m. CT on the Saturday immediately following the third Friday of the expiration month
  - Notice of intent to exercise a trade may be earlier

# SPECIFICATION OF STOCK OPTIONS

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- The exchange chooses the strike price at which options can be written
- Strike prices are spaced \$2.5, \$5, or \$10 apart
- For any given stock, there are many options traded
- They are different in maturities, or strike prices (examples: IBM options)



# TERMINOLOGY

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- $S$ : stock price
- $K$ : strike price
  - Another commonly used variable for this is:  $X$
- Option Class: “IBM Call”
- Option Series: “IBM 70 October Call”

# TERMINOLOGY

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- In-the-money (ITM) options
  - Lead to a positive cash flow if it were exercised now
  - For calls,  $S - K > 0$
  - For puts,  $K - S > 0$
  - Examples: IBM options
- Out-of-the-money (OTM) options
  - Lead to a negative cash flow if it were exercised now
  - For calls,  $S - K < 0$
  - For puts,  $K - S < 0$
- At-the-money (ATM) options
  - Lead to a zero cash flow if it were exercised now

# BASIC OPTION POSITIONS

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- There are 4 basic option positions:
  - Long call
  - Short call
  - Long put
  - Short put
- We'll look at the Payoff and Profit of each position:
  - $\text{Payoff} = \text{Value of the option at expiration}$
  - $\text{Profit} = \text{Payoff} - \text{price paid for option}$
- We assume options are European.

# EXAMPLE OF A CALL OPTION

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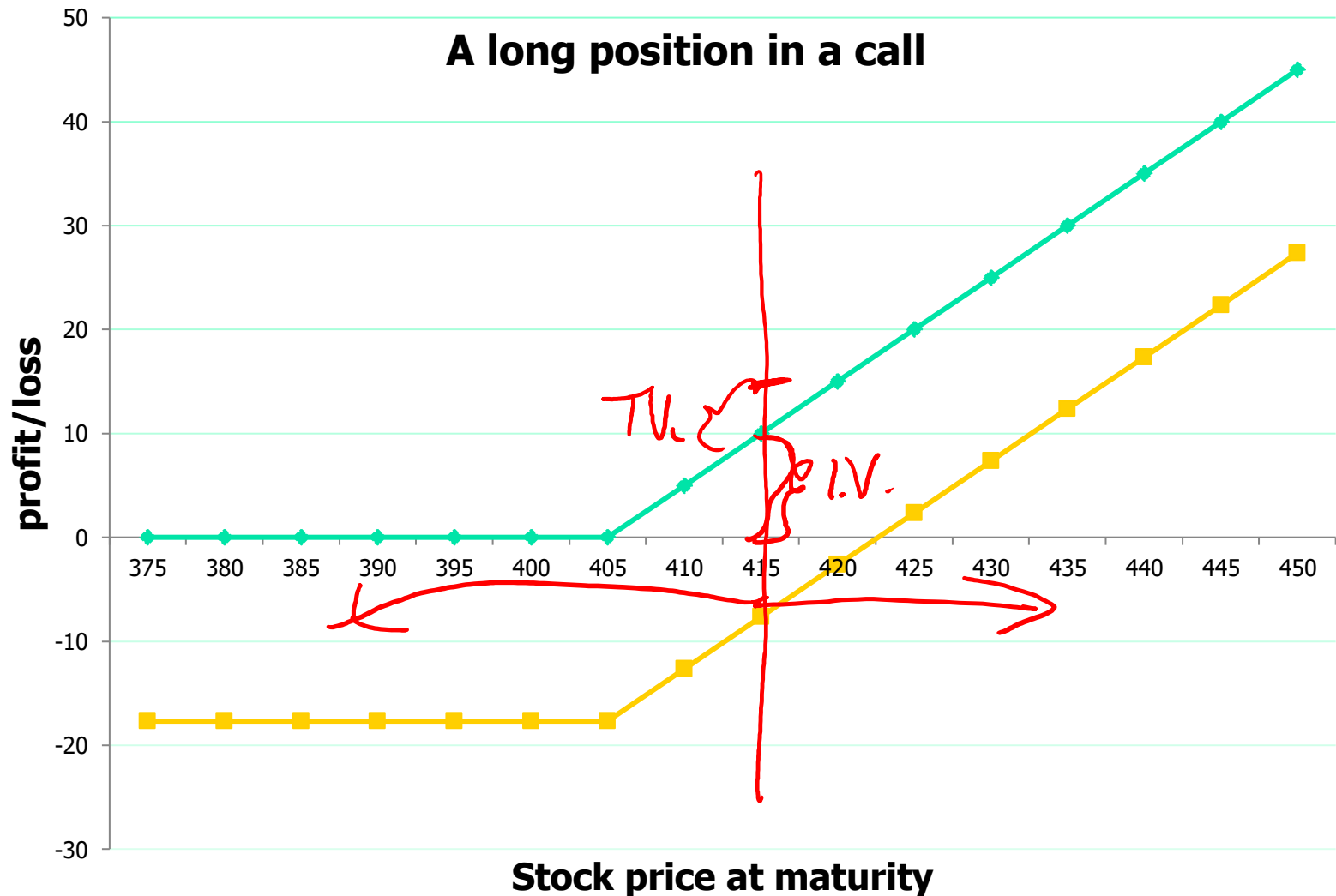
- An investor buys a call option written on 100 shares
- 10/25/2021
- $K = \$405$
- $S_0 = \$400$
- The option expires in one month
- Option price  $C_t = \$17.65$

# EXAMPLE OF A CALL OPTION

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- On the expiration day, the value of the option is  $C_T = \max(0, S_T - K)$
- If  $S_T < K$ , option value = 0
- If  $S_T > K$ , option value =  $S_T - K$
- If  $S_T = 425$ , option value =  $425 - 405 = 20$
- Profit =  $20 - 17.65 = \$2.35$

# PAYOFF AND PROFIT DIAGRAMS



# EXAMPLE OF A PUT OPTION

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- An investor buys a put option written on Apple shares
- $K = \$405$
- $S_t = \$400$
- The option expires in one month
- Option price  $P_t = \$20$

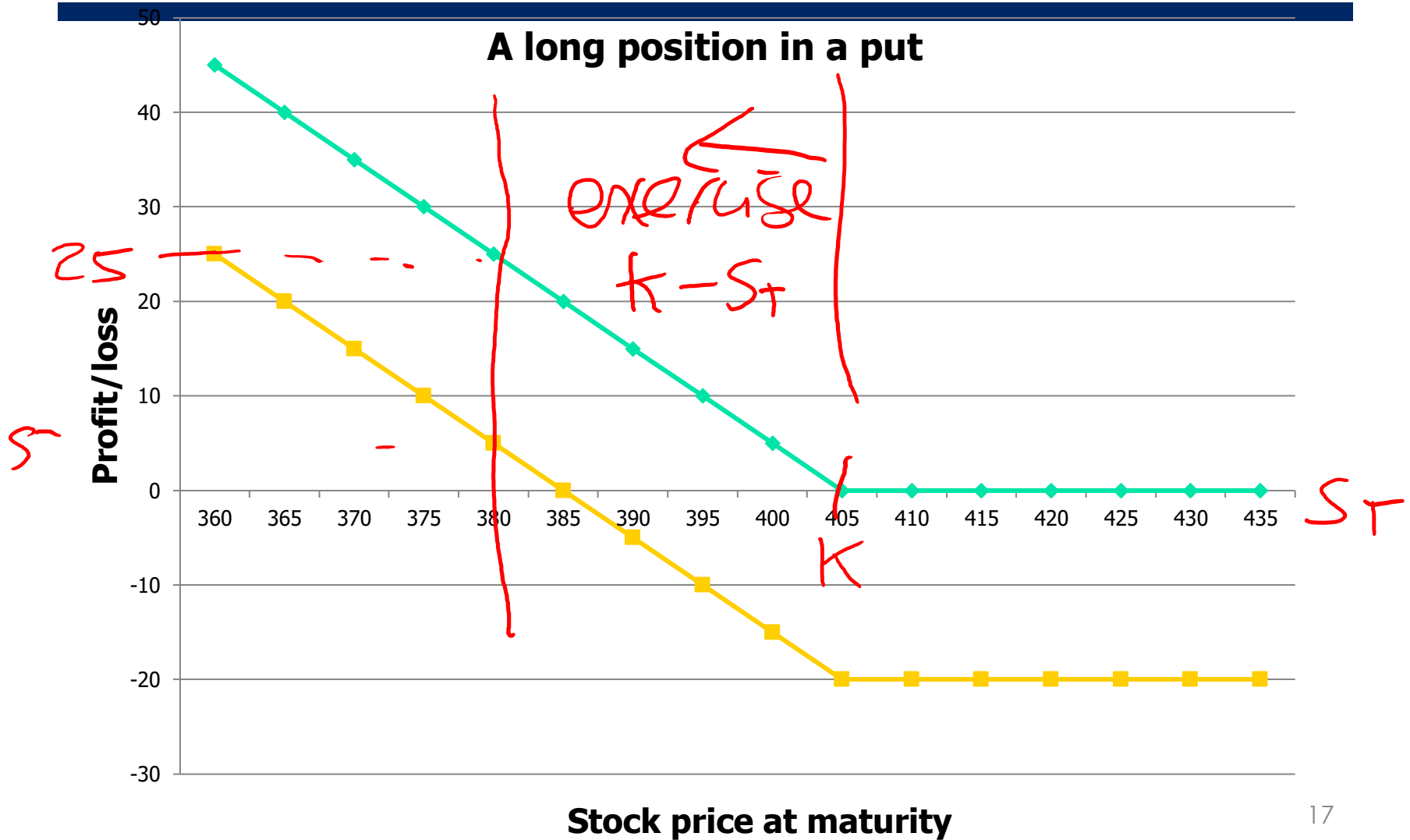
# EXAMPLE OF A PUT OPTION

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- On the expiration day, the value of the option is  $P_T = \max(0, K - S_T)$ 
  - If  $S_T > K$ , option value = 0
  - If  $S_T < K$ , option value =  $K - S_T$
  - If  $S_T = 380$ , option value =  $\$405 - 380 = 25$
  - Profit =  $25 - 20 = \$5$



# PAYOFF AND PROFIT DIAGRAMS



# PAYOFF AND PROFIT DIAGRAMS

## EXAMPLE (EXCEL)

### OPTION PAYOFFS AND PROFITS

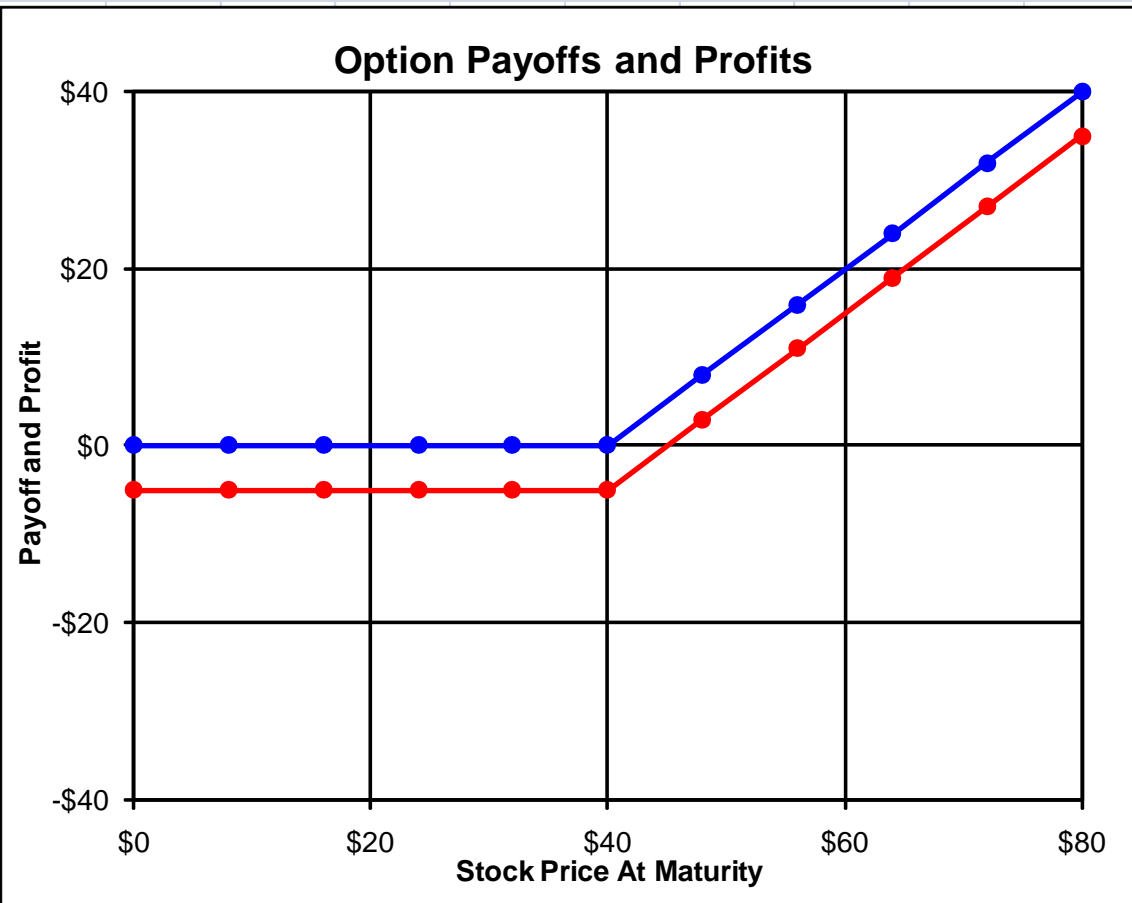
Basics

Buy

Call

#### Inputs

Buy or Sell: 1 = Buy, -1 = Sell	1
Option Type: 1=Call, 2=Put	1
Exercise Price	\$40.00
Option Price	\$5.00



#### Outputs

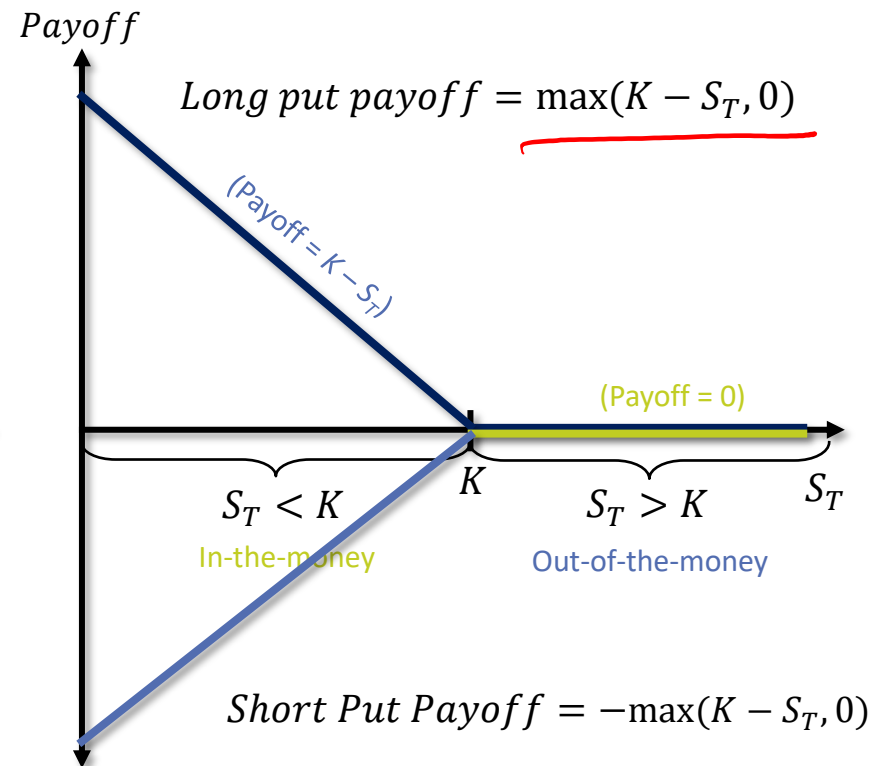
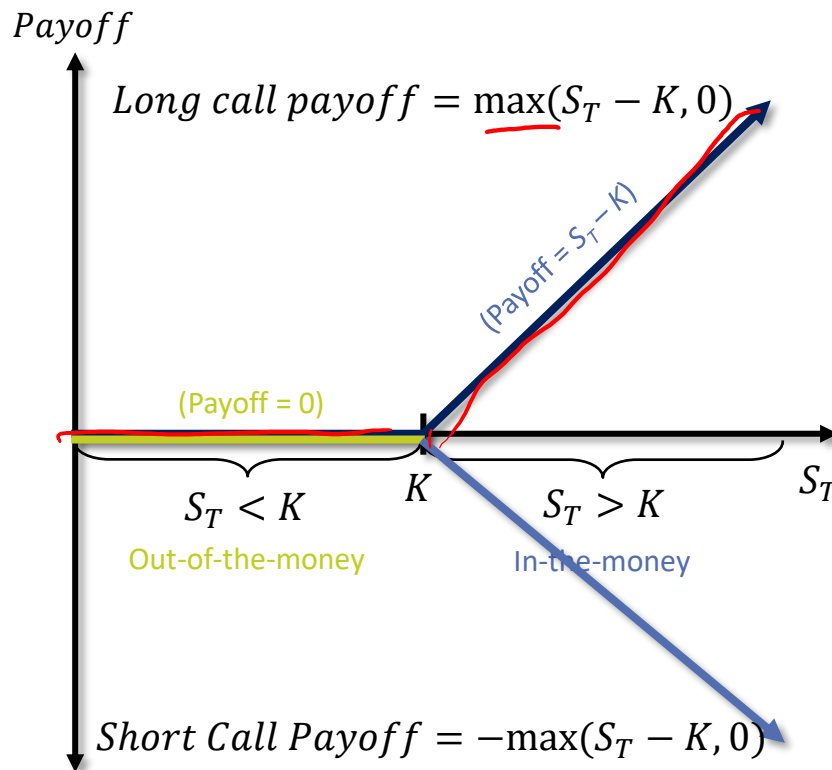
Stock Price At Maturity	\$0.00	\$8.00	\$16.00	\$24.00	\$32.00	\$40.00	\$48.00	\$56.00	\$64.00	\$72.00	\$80.00
Option Payoff	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$0.00	\$8.00	\$16.00	\$24.00	\$32.00	\$40.00
Option Profit	-\$5.00	-\$5.00	-\$5.00	-\$5.00	-\$5.00	-\$5.00	\$3.00	\$11.00	\$19.00	\$27.00	\$35.00

# UPSIDE VS DOWNSIDE

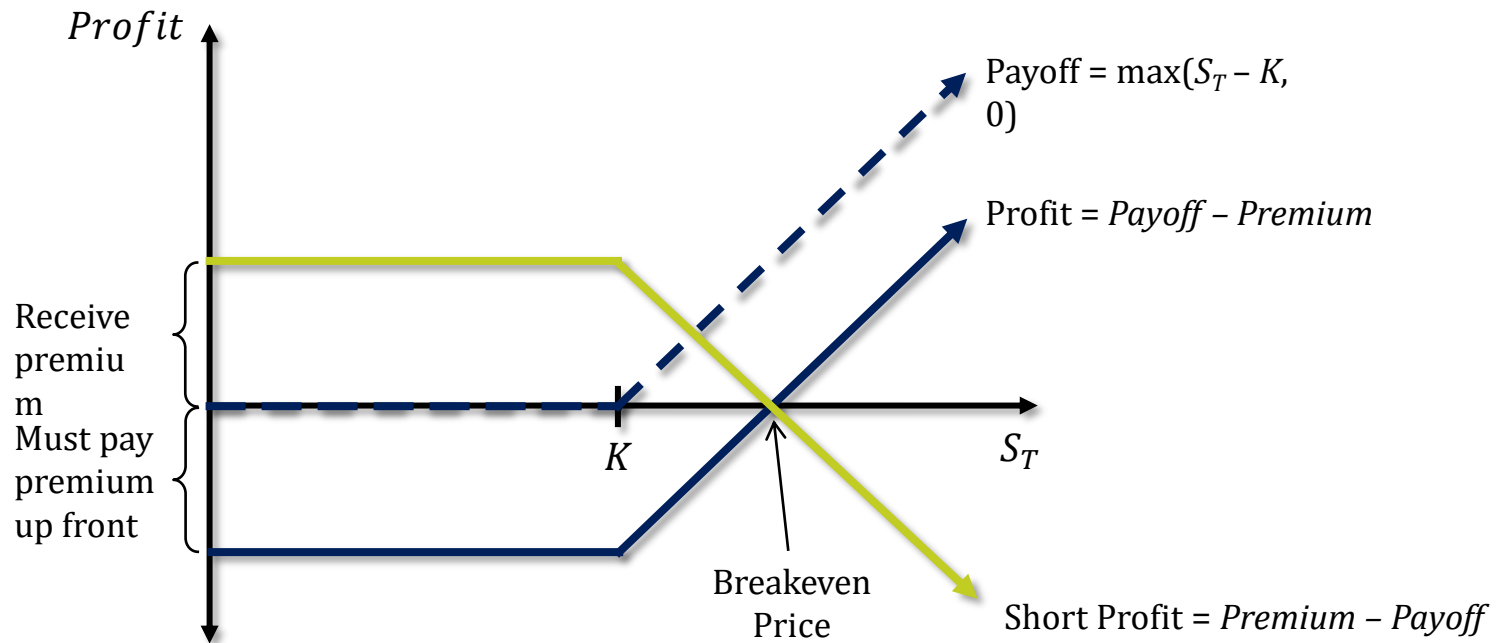
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	MAX UPSIDE	MAX DOWNSIDE
Long Call	Unlimited	Premium
Long Put	Large	Premium
Short Call	Premium	Unlimited
Short Put	Premium	Large

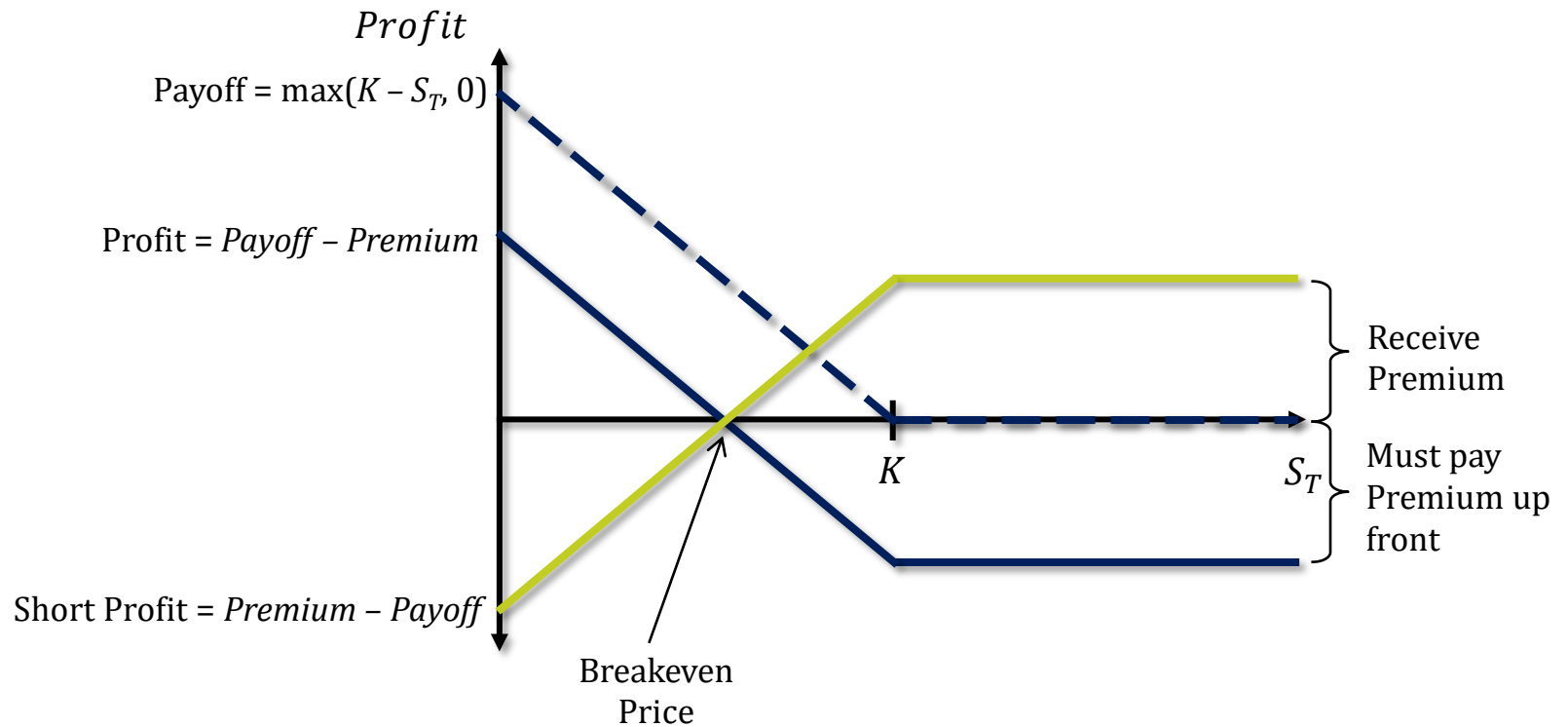
# CALL AND PUT PAYOFFS (VALUE AT EXPIRATION)



# CALL PROFIT



# PUT PROFIT



# STOCK INDEX OPTIONS: EXAMPLE

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- Strike:  $K = 980$
- Index level at expiration:  $S_T = 992$
- Contract is on 100 x index
- Cash settlement
- When the long exercises the call option, the short party will have to pay to the long:
  - $(992 - 980) * 100 = \$1,200$

$$(S_T - K) \times 100 = 1200$$

# APPLE: CALL OPTIONS (10/7/2019)

Today: 2019/10/7

Expiration date:  
2019/10/25

AAPL: \$228

Contract N	Strike	Last Price	Bid	Ask	Change	% Change	Volume	Open Inte	Implied Volatility
AAPL1910	210.00	20.27	20.00	20.15	2.33	12.99%	129	597	34.67%
AAPL1910	212.50	17.71	17.75	17.90	1.66	10.34%	36	418	33.40%
AAPL1910	215.00	15.55	15.45	15.65	1.75	12.68%	28	641	31.73%
AAPL1910	217.50	13.50	13.35	13.50	1.25	10.20%	38	434	30.35%
AAPL1910	220.00	11.35	11.35	11.45	1.42	14.30%	319	7,344	29.08%
AAPL1910	222.50	9.45	9.30	9.40	1.28	15.67%	110	2,131	27.26%
AAPL1910	225.00	7.65	7.55	7.70	1.15	17.69%	810	10,128	26.66%
AAPL1910	227.50	6.00	6.00	6.10	1.02	20.48%	477	2,118	25.75%
AAPL1910	230.00	4.60	4.55	4.65	0.81	21.37%	556	3,575	24.72%
AAPL1910	232.50	3.51	3.35	3.45	0.80	29.52%	845	1,845	23.96%
AAPL1910	235.00	2.43	2.40	2.43	0.51	26.56%	758	1,509	23.08%
AAPL1910	237.50	1.74	1.61	1.67	0.46	35.94%	190	955	22.52%
AAPL1910	240.00	1.12	1.09	1.11	0.29	34.94%	538	1,217	22.10%
AAPL1910	242.50	0.70	0.70	0.72	0.14	25.00%	98	813	21.83%
AAPL1910	245.00	0.44	0.44	0.47	0.09	25.71%	1,109	984	21.83%
AAPL1910	247.50	0.29	0.29	0.30	0.05	20.83%	14	413	21.85%
AAPL1910	250.00	0.19	0.19	0.21	0.04	26.67%	1,237	459	22.36%

In-the-  
money  
calls

Out-of-the-  
money  
calls



# APPLE: CALL OPTIONS (10/14/2020)

Today: 2020/10/14

Expiration date: 2020/10/23

AAPL: \$121( \$121x4=\$484)

Contract Name	Strike	Price	Bid	Ask	Volume	Open Interest	Implied Volatility
<a href="#">AAPL20102</a>	<a href="#">100</a>	21.35	21.05	21.4	70	1,139	53.52%
<a href="#">AAPL20102</a>	<a href="#">105</a>	16.5	16.1	16.45	82	1,166	58.30%
<a href="#">AAPL20102</a>	<a href="#">110</a>	11.42	11.35	11.55	629	17,272	46.39%
<a href="#">AAPL20102</a>	<a href="#">115</a>	7.08	6.95	7.15	7,288	10,616	42.29%
<a href="#">AAPL20102</a>	<a href="#">120</a>	3.7	3.7	3.75	21,513	20,082	41.28%
<a href="#">AAPL20102</a>	<a href="#">125</a>	1.66	1.65	1.68	36,494	31,432	41.94%
<a href="#">AAPL20102</a>	<a href="#">130</a>	0.71	0.7	0.73	44,298	30,552	44.63%
<a href="#">AAPL20102</a>	<a href="#">135</a>	0.34	0.32	0.35	6,253	12,360	48.73%
<a href="#">AAPL20102</a>	<a href="#">140</a>	0.19	0.18	0.19	4,822	8,237	53.13%
<a href="#">AAPL20102</a>	<a href="#">145</a>	0.12	0.1	0.12	2,002	3,664	57.91%
<a href="#">AAPL20102</a>	<a href="#">150</a>	0.07	0.07	0.09	3,136	8,496	63.67%
<a href="#">AAPL20102</a>	<a href="#">155</a>	0.05	0.02	0.05	557	2,482	64.45%

In-the-money calls

Out-of-the-money calls

# APPLE: PUT OPTIONS (10/14/2020)

Today: 2020/10/14

Expiration date: 2020/10/23

AAPL: \$121( \$121x4=\$484)

Contract Name	Strike	Price	Bid	Ask	Volume	Open Interest	Implied Volatility
<a href="#">AAPL201016P00</a>	<a href="#">100</a>	0.01	0	0.01	383	35,206	90.63%
<a href="#">AAPL201016P00</a>	<a href="#">105</a>	0.01	0.01	0.02	1,042	34,642	78.91%
<a href="#">AAPL201016P00</a>	<a href="#">110</a>	0.03	0.02	0.04	4,360	62,373	60.94%
<a href="#">AAPL201016P00</a>	<a href="#">115</a>	0.1	0.09	0.1	25,733	76,829	45.31%
<a href="#">AAPL201016P00</a>	<a href="#">120</a>	0.89	0.88	0.9	118,750	51,307	39.75%
<a href="#">AAPL201016P00</a>	<a href="#">125</a>	4.05	4	4.2	11,486	23,728	45.02%
<a href="#">AAPL201016P00</a>	<a href="#">130</a>	8.7	8.75	8.9	961	15,439	55.27%
<a href="#">AAPL201016P00</a>	<a href="#">135</a>	13.22	13.65	13.9	72	2,722	78.13%
<a href="#">AAPL201016P00</a>	<a href="#">140</a>	18.35	18.65	18.9	83	653	99.22%
<a href="#">AAPL201016P00</a>	<a href="#">145</a>	23.55	23.65	23.9	33	403	119.14%

Out-of-the-money puts

In-the-money puts

# HISTORY OF APPLE'S STOCK SPLIT

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- Signaling
- Better liquidity
- 8/24/2020: 4-for-1
- 6/9/2014: 7-for-1
- 2/28/2005: 2-for-1

# APPLE: STOCK SPLIT (2020)



# APPLE: STOCK SPLIT (2014)



# ADJUSTMENT FOR STOCK SPLITS

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- If a company decides to have a  $n$ -for- $m$  stock split, the exchange often adjusts the terms of the option contracts written on the stock
  - The new contract will be written on  $n/m$  times the number of shares of the old contract
  - The new contract will have a strike price of  $m/n$  times the old strike
- Example: How does a 3-for-1 stock split affect a call option with a strike price of \$60?

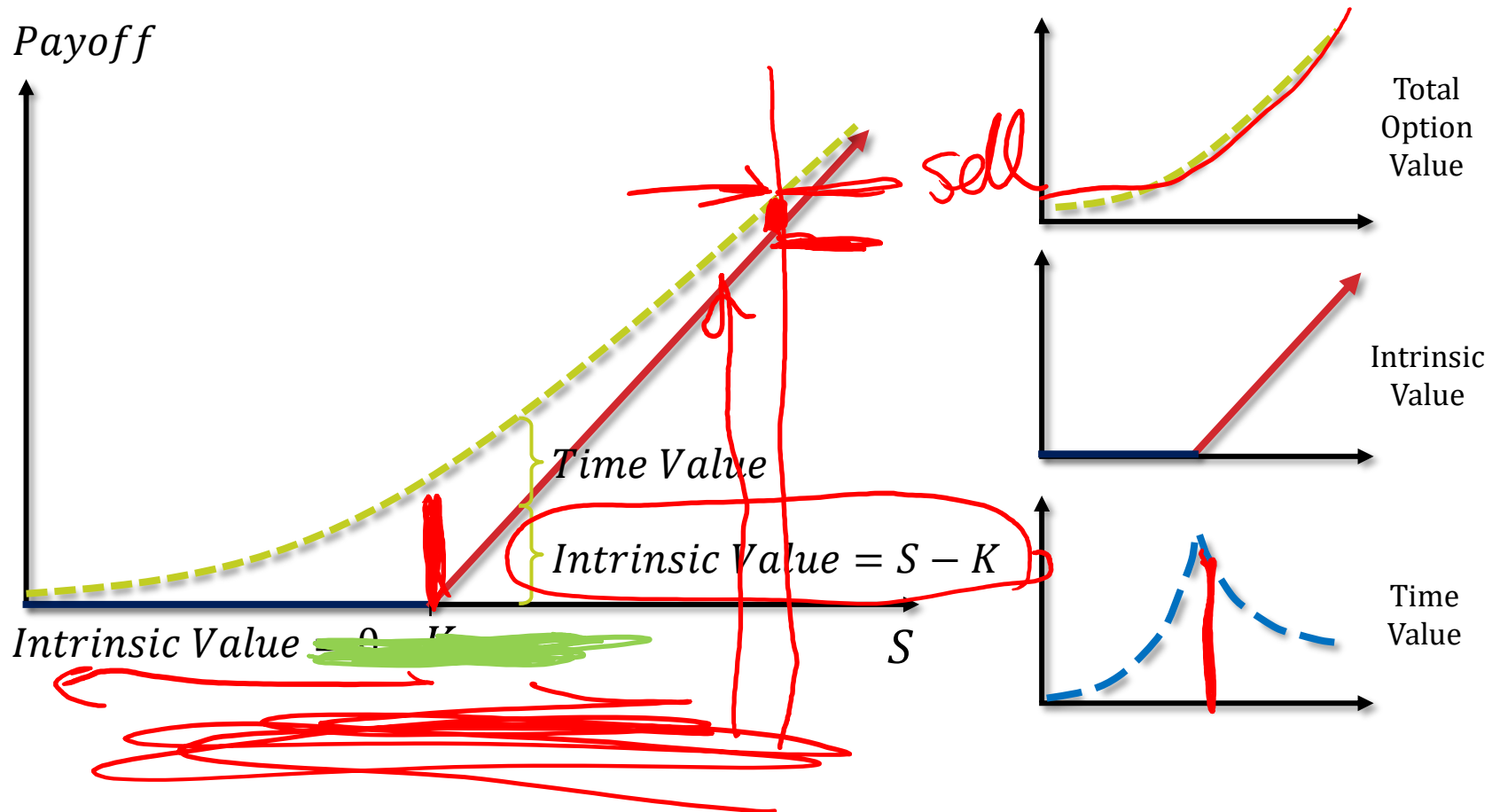
# OPTION VALUE (PRIOR TO EXPIRATION)

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$$\text{Value} = \underbrace{\text{Intrinsic Value}}_{\substack{\text{Amount by which} \\ \text{option is ITM}}} + \underbrace{\text{Time Value}}_{\substack{\text{Amount by which} \\ \text{option value exceeds} \\ \text{intrinsic value}}}$$

$\text{Call} = \max(S - K, 0)$   
 $\text{Put} = \max(K - S, 0)$

# CALL OPTION VALUE





# WHAT IS TIME VALUE?

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- Reflects possibility the option could finish (further) ITM.
- Time value increases with:
  - Time until expiration:** The more time left, the greater the chance of the option finishing ITM
  - Volatility of stock:** the more volatile the underlying, the greater the chance of the option finishing ITM

Find an option from FactSet and calculate intrinsic value and time value

# TRADING OPTIONS

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- Market makers: quote bid and ask prices
  - They facilitate trading, add liquidity
- For stocks:
  - Initial margin: 50% of the value of the shares
  - Maintenance margin: 25% of the value of the shares
- When calls/puts with maturities *less than 9 months* are purchased, the option price must be paid in full
  - You can not buy options on margin
  - Options already contain leverage
  - Buying on margin will increase leverage even further

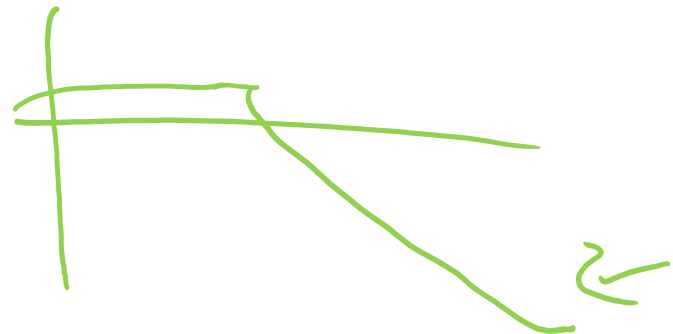
# TRADING OPTIONS

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- If maturities are longer than 9 months
  - 75% margin
  - Borrow up to 25% of the option value

# TRADING OPTIONS

- When <sup>short</sup> writing options, a trader is required to maintain funds in a margin account
  - Reduce the default risk when the other party exercises the option
  - The amount of margin depends on the position
- Writing naked options: option position is not combined with an offsetting position in the underlying asset



# WRITING NAKED OPTIONS

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- When writing a naked option, the investor gets the premium:
  - Because losses can exceed the premium, there are initial and maintenance margin requirements.

**Initial and Maintenance Margin for Naked Calls and Puts – greater of:**

*Contract Size  $\times$  (Premium + 0.20S – Amount OTM)*

*Or*

*Contract Size  $\times$  (Premium + 0.10S) **Calls***

*Contract Size  $\times$  (Premium + 0.10K) **Puts***

# NAKED OPTION POSITION EXAMPLE

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- An investor writes four naked call option contracts on a stock. The option price is \$5 and  $K = \$40$ . What is the margin requirement if the stock price is \$38?

Margin Requirement for Naked Call – greater of:

$\text{Contract Size} \times (\text{Premium} + 0.20S - \text{Amount OTM})$

$\text{Contract Size} \times (\text{Premium} + 0.10S)$

# TERMINATING AN OPTION POSITION

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- Three ways to terminate an option position:
  - Sell the option.
  - Exercise the option.
  - Let the option expire worthless.

# COMPETITION FROM OTC MARKETS

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- Exchange traded options are standardized (plain vanilla)
- OTC markets offer products with a wide variety of non-standard contract terms (exotic options):
  - Bermuda options – Exercise can occur only on certain dates.
  - Lookback options – Option exercise value depends on the path of underlying stock.
  - Chooser options – After specified date, can choose whether option is call or put.
  - Binary options – Pays zero if  $S_T < K$  or a fixed amount  $Q$  if  $S_T > K$ .
  - Shout options – Holder can “shout” to the writer one time during life of option. Payoff = European payoff at end of option’s life or intrinsic value at time of shout.
  - Asian options –
    - Call payoff =  $\max(S_{\text{ave}} - K, 0)$
    - Put payoff =  $\max(K - S_{\text{ave}}, 0)$



# COMPETITION FROM OTC MARKETS

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- To regain business from OTC markets the CBOE has developed a number of non-standard products:
  - FLEX Options – Can specify nonstandard strike prices or expiration dates.
  - Weeklys – Options created on Thursday and expire the following Friday.
  - Binary Options – Pay zero if  $S_T < K$  or \$100 if  $S_T > K$ .
  - Credit Event Options – Provide a fixed payoff if a credit event occurs.
  - DOOM Options – Deep Out Of the Money put options. Cost very little with high payoff if underlying asset plunges.

# OTHER SECURITIES SIMILAR TO OPTIONS

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- Warrants
- Executive Stock Options
- Convertible Bonds

# WARRANTS

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- Warrants are options that are issued (or written) by a corporation or a financial institution
  - SPACs often sell units consisting of a share + some warrants!
- The issuer settles with the holder when a warrant is exercised
- When call warrants are issued by a corporation on its own stock, exercise will lead to new stocks being issued
- The most actively traded warrants in the world:
  - Hong Kong and Germany

# EXECUTIVE STOCK OPTIONS

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- Options issued by a company to its executives
- Usually these options are at-the-money when issued
- They become vested after a period of time (usually 1 to 4 years)
- They cannot be sold
- They often last for 10 - 15 years

# CONVERTIBLE BONDS

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- Convertible bonds are regular bonds that can be exchanged for equity at certain times in the future according to a predetermined exchange ratio

# SUMMARY

- Option contracts give the owner the right to buy (call) or sell (in case of a put) an asset for the strike price by the expiration date
- Payoff and profit is determined by:
  - *Long Call Payoff*  $= \max(S_T - K, 0)$
  - *Short Call Payoff*  $= -\max(S_T - K, 0) = \min(K - S_T, 0)$
  - *Long Put Payoff*  $= \max(K - S_T, 0)$
  - *Short Put Payoff*  $= -\max(K - S_T, 0) = \min(S_T - K, 0)$
- Margin requirements depend on position type
- Option value consists of intrinsic & time value

**VILLANOVA UNIVERSITY  
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**Finance 2325**

**Homework 11**

**Chapter 9. Mechanics of Options Markets**

Chapter 9: 1, 4, 9, 11, 14, 16, 19, 24, 27