

Finance 34600 - Investment Theory

Outline for Lecture 7 Options and Option Pricing

Lecture 7 covers the characteristics, payoffs, and pricing of options. We will first discuss the basic characteristics of long and short positions in Put and Call options and provide a comparison to long and short positions in the underlying stock. At the same time we will calculate and plot both the payoffs and profits from these positions.

We will then discuss the payoffs and profits associated with various combinations of stock, bond, and option positions. These positions will include covered calls, protective puts, and several options strategies such as straddles, and spreads.

The remaining parts of lecture 7 cover the valuation of options. We will not have time to cover all of this material in class. This topic begins by deriving the basic Put-Call Parity relation for the relative valuation of Puts and Calls. It then goes on to discuss two methods for pricing options: the Binomial Option Pricing Model and the Black-Scholes Option Pricing Model.

Suggested Problems:

Supplemental Problems I-III.

Ch. 15: 1, 6, 9.

Ch. 16: Not covered.

Handout: Additional Problems Handout #1-5, 11-13.
Note that problems 1-16 in the handout provide additional examples related to option payoffs and combinations of options, while problems 17-21 cover Put-Call Parity and arbitrage opportunities in Options.

Supplemental Problems:

- I) In each case below, describe which option would be more valuable and why. Assume the stock prices on IBM and Intel are both \$80, the standard deviation of IBM is 20% and the standard deviation of Intel is 35%. Also, assume that all features of the options other than those listed are identical.
- a Call option on IBM with $X=90$ or a Call option on IBM with $X=100$.
 - a Call option on IBM with $X=90$ or a Put option on IBM with $X=90$.
 - a Call option on IBM with $X=90$ and 3 months to expiration or a Call option on IBM with $X=90$ and 6 months to expiration.
 - a Call option on IBM with $X=90$ or a Call option on Intel with $X=90$.
- II) Draw the payoffs and profits to each of the following positions.
- Long one share of stock, $S=\$10$
 - Long one Call option ($X=\$20$), $C=\$5$
 - Write (short) one Call option ($X=\$20$), $C=\$5$
 - Long one Put option ($X=\$20$), $P=\$5$
 - Write (short) one Put option ($X=\$20$), $P=\$5$
- III) Using the Google option prices provided in your notes, calculate the payoff and profit for investments in each of the following June maturity options. Assume the stock price on Google at the maturity date is \$590.
- Long Call option, $X=500$
 - Long Put option, $X=500$
 - Long Call option, $X=600$
 - Long Put option, $X=600$
 - Short Call option, $X=600$
 - Short Put option, $X=600$

Chapter 15 Problems:

1. Which of the following statements about the value of a call option at expiration is false?
- A short position in a call option will result in a loss if the stock price exceeds the exercise price.
 - The value of a long position equals zero or the stock price minus the exercise price, whichever is higher.
 - The value of a long position equals zero or the exercise price minus the stock price, whichever is higher.
 - A short position in a call option has a zero value for all stock prices equal to or less than the exercise price.

6. The common stock of P.U.T.T. Corporation has been trading in a narrow price range for the past month and you are convinced it is going to break far out of that range in the next three months. You do not know whether it will go up or down, however. The current price of the stock is \$100 per share, the price of a three-month call option with $X=100$ is \$10, and a put with the same expiration date and exercise price costs \$7.
- What would be a simple options strategy to exploit your conviction about the stock price's future movements?
 - How far would the price have to move in either direction for you to make a profit on your initial investment?
9. Options positions:
- A butterfly spread is the purchase of one call at $X=X_1$, the sale of two calls at $X=X_2$, and the purchase of one call at $X=X_3$. Note that X_1 is less X_2 and X_2 is less than X_3 by equal amounts, and all calls have the same expiration date. Graph the payoff diagram to this strategy.
 - A vertical combination is the purchase of a call with exercise price X_2 and a put with exercise price X_1 , with $X_2 > X_1$. Graph the payoff to this strategy.

Additional Problems Related to Options

Note: Solutions to these problems are provided at the end of the handout.

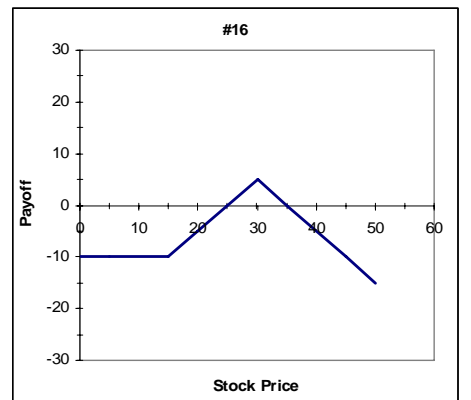
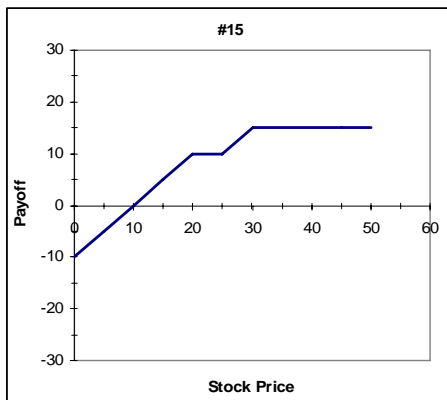
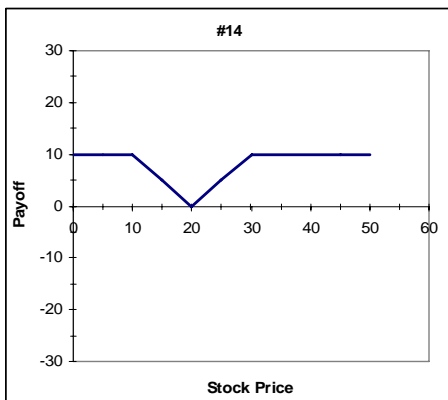
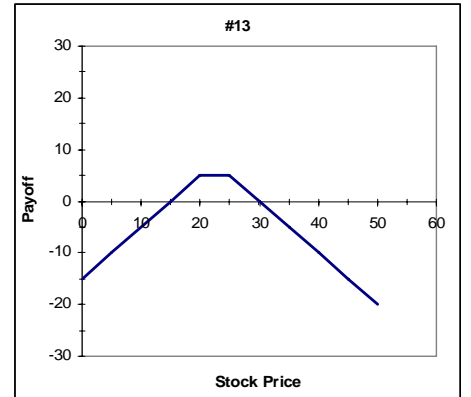
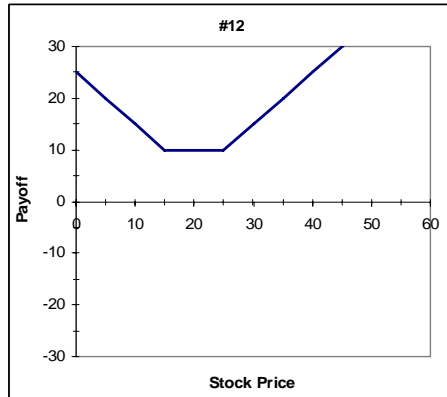
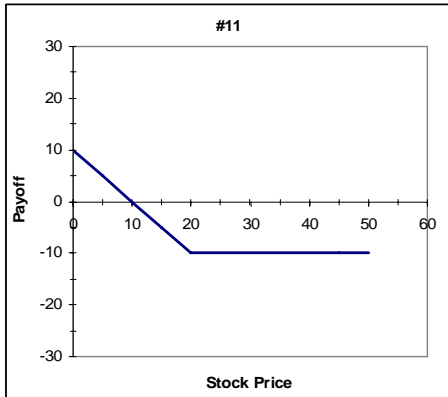
Option Payoffs Part I: The prices of put options and call options with exercise prices ranging from \$5 to \$35 are shown in the table below. All options have one year to expiration. The table also shows the prices of one-year risk-free zero-coupon bonds with face values ranging from \$5 to \$35 (For example, the first bond costs \$4.50 today and pays off \$5 at the maturity date). Using this information, answer questions 1 through 10 by doing the following:

- a) Sketch the payoff and profit diagrams for the strategy.
- b) Describe the range of stock prices for which the strategy provides positive profits.
- c) Describe the maximum potential profits and losses.

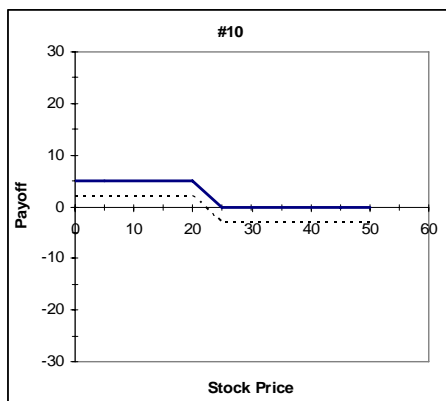
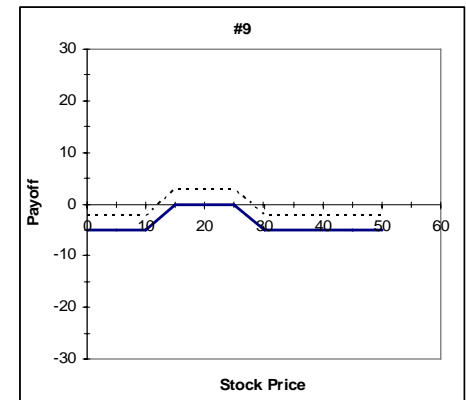
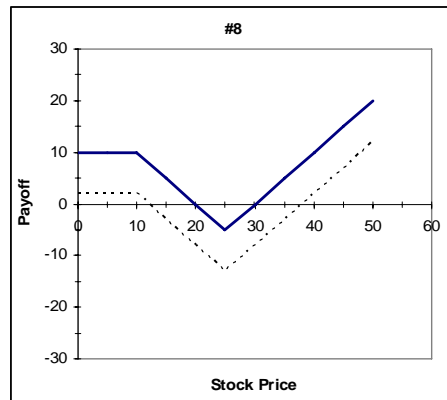
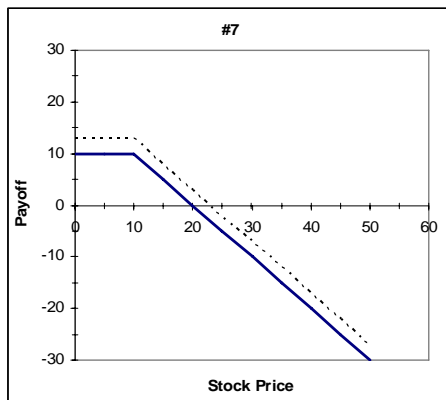
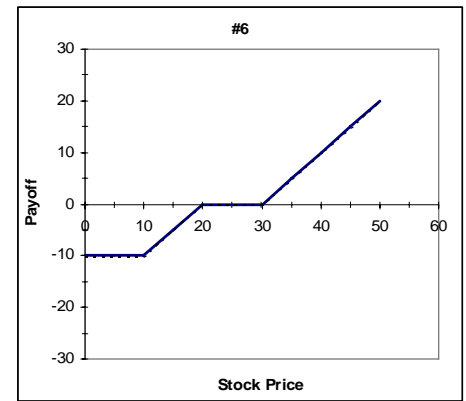
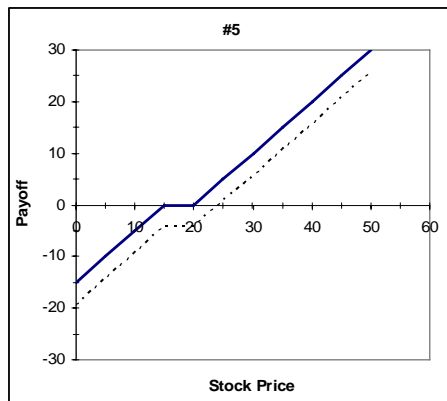
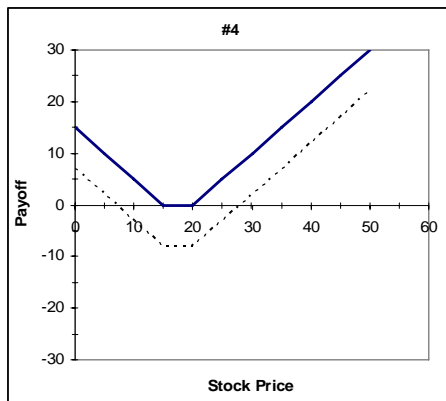
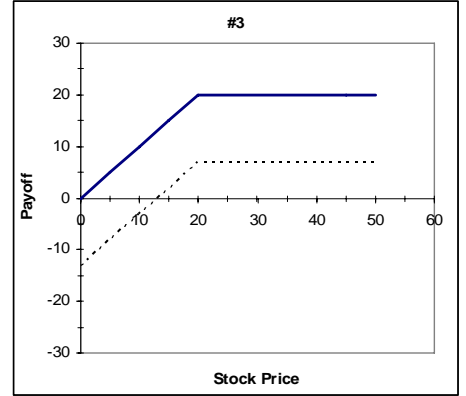
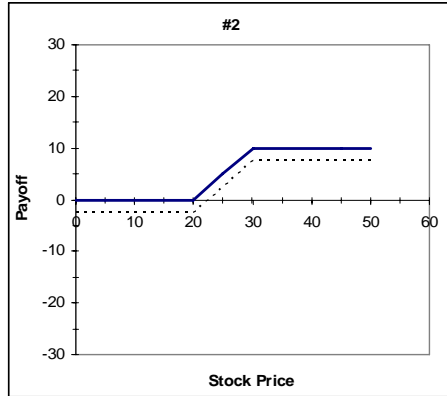
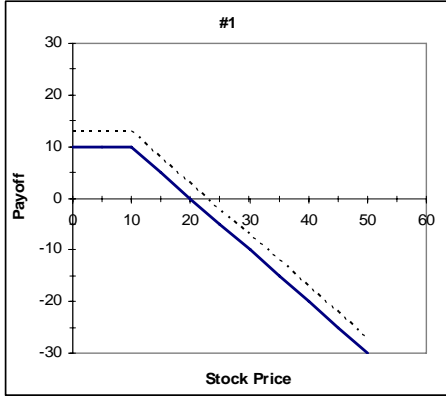
<i>X</i> or <i>FV</i>	Call Premium	Put Premium	Bond Price
\$ 5	\$ 15.60	\$ 0.10	\$ 4.50
10	11.80	0.90	9.00
15	9.00	2.60	13.60
20	6.90	5.00	18.10
25	5.40	8.00	22.60
30	4.30	11.40	27.10
35	3.40	15.10	31.70

1. Short one call, $X=10$; Long one bond, $FV=10$.
2. Long one call, $X=20$; Short one call, $X=30$
3. Long one share of stock; short one call, $X=20$.
4. Long one put, $X=15$; Long one call, $X=25$
5. Short one put, $X=15$; Long one call, $X=20$.
6. Long one put, $X=10$; Short one put, $X=20$; Long one call, $X=30$.
7. Short one put, $X=10$; Long one put, $X=20$; Short one call, $X=20$
8. Long two calls, $X=25$; Short one call, $X=10$; Long one bond, $FV=10$.
9. Long one put, $X=10$; Short one put, $X=15$; Short one call, $X=25$; Long one call, $X=30$
10. Short one share of stock; Short one put, $X=20$; Long one bond, $FV=25$; Long one call, $X=25$.

Options Payoffs Part II: For problems 11 through 16, describe the strategy depicted by each payoff diagram (you will be describing long and short positions in various securities, as I did in questions 1-10).



Option Problem Solutions



The following table describes the profits on the options strategies from problems 1 through 10.

Problem	b) Profitable Range	c) Maximum Profit	c) Maximum Loss
1	$S < \$22.80$	\$12.80	Unlimited
2	$S > \$22.60$	\$7.40	\$2.60
3	$S > \$13.10$	\$6.90	\$13.10
4	$S < \$7.00$ and $S > \$33.00$	Unlimited	\$8.00
5	$S > \$24.30$	Unlimited	\$19.30
6	$S > \$30.20$	Unlimited	\$10.20
7	$S < \$22.80$	\$12.80	Unlimited
8	$S < \$12.00$ and $S > \$38.00$	Unlimited	\$13.00
9	$\$12.20 < S < \27.80	\$2.80	\$2.20
10	$S < \$22.00$	\$2.00	\$3.00

There are multiple correct answers for problems 11 through 16. Two possible answers for each problem are listed here:

11. Answer 1: Long Bond(FV=10); Short Stock; Long Call(X=20)
Answer 2: Long Put(X=20); Short Bond(FV=10)
12. Answer 1: Long Bond(FV=25); Short Stock; Long Call(X=15); Long Call(X=25)
Answer 2: Long Put(X=15); Long Call(X=25); Long Bond(FV=10)
13. Answer 1: Short Bond(FV=15); Long Stock; Short Call(X=20); Short Call(X=25)
Answer 2: Short Put(X=20); Short Call(X=25); Long Bond(FV=5)
14. Answer 1: Long Bond(FV=10); Short Call(X=10); Long 2 Calls(X=20); Short Call(X=30)
Answer 2: Long Put(X=20); Short Put(X=10); Long Call(X=20); Short Call(X=30)
15. Answer 1: Short Bond(FV=10); Long Stock; Short Call(X=20); Long Call(X=25); Short Call(X=30)
Answer 2: Short Put(X=20); Long Call(X=25); Short Call(X=30); Long Bond(FV=10)
16. Answer 1: Short Bond(FV=10); Long Call(X=15); Short 2 Calls(X=30)
Answer 2: Short Put(X=30); Long Put(X=15); Short Call(X=30); Long Bond(FV=5).