Trading Strategies Involving Options

BUSS386. Futures and Options

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Lecture Outline

- Protected Principal Notes
- Options + Underlying Assets
- Spreads: Bull, Bear, Butterfly, Calendar
- Straddle and Strangle
- Reading: Chp. 12

Trading Strategies Involving Options

- We can combine an option with bond, underlying assets, or other options and create many different payoff patterns.

- Thus, a portfolio can be constructed to meet investors' demand based on their preference or perspectives on the market.

  e.g. An investor expects a big swing in Russian ruble after the presidential election in the US. How to make profits in such a case?

- Examples of strategies involving options
  - Protected principal note
  - Covered call
  - Spreads
  - Straddle/Strangle
  - ...

Protected Principal Note

- This is an investment strategy where investors do not lose any of principal (initial investment) and sometimes earn additional profits.

- The portfolio consists of a bond and an option (either call or put).

e.g. A bank offers \$1,000 investment opportunity. If an investor invests \$1,000, the bank guarantees to pay back \$1,000 three years from now and additional profits in some cases. The risk-free interest rate is 6%. Also available is a 3-year call option on a stock index with the strike price of 1,500. The option price is \$160.

Protected Principal Note

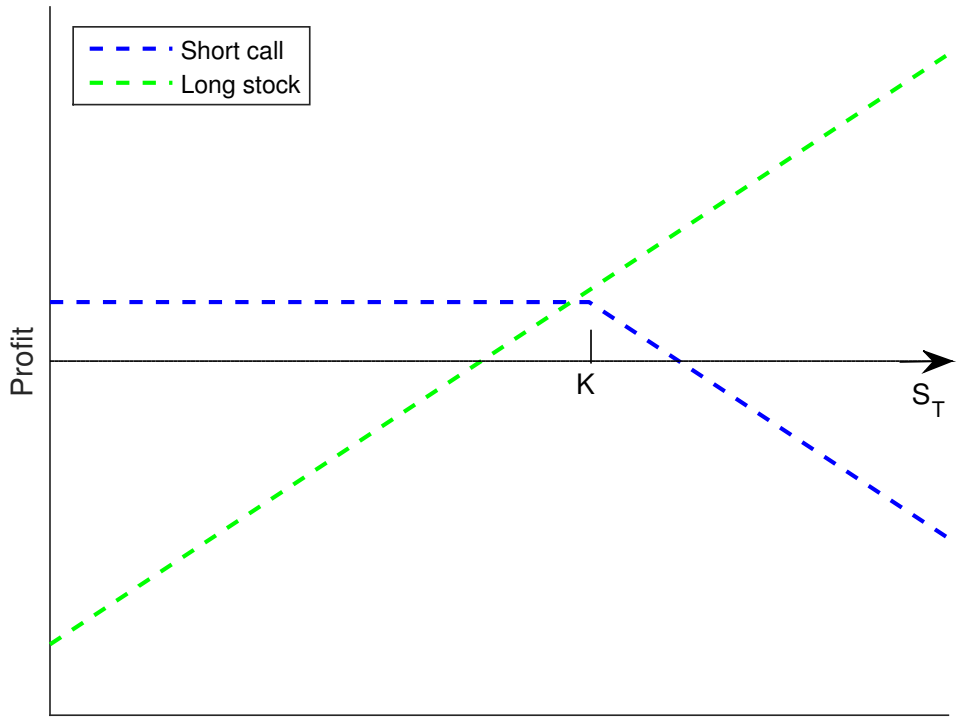
- To construct the strategy, the bank buys ...
  1. 3-year zero coupon bond with the face value of 1,000.
     - In the bond purchase, the bank pays $1,000e^{-0.06\times 3} = 835.3$, so $(1,000 - 835.3) = 164.7$ remains.
  2. Call option on a stock index
     - Use the remaining proceeds to buy the call.

- In year 3, the portfolio value is

$$1000 + \max(S_T - 1500, 0).$$

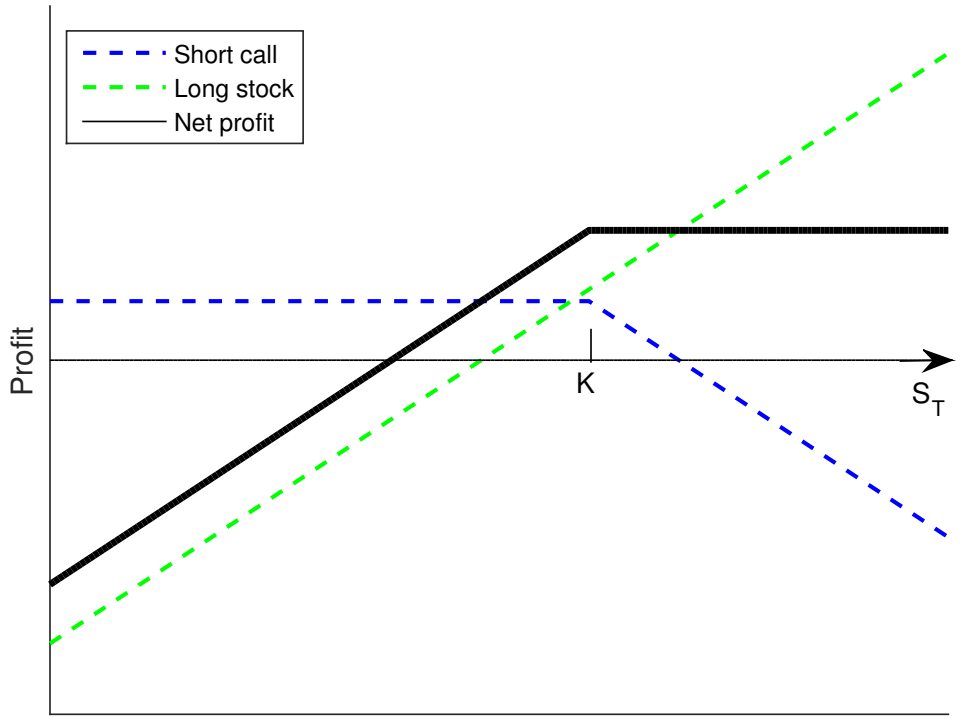
Trading Option and Underlying Asset

1. Writing a covered call
   - Suppose that we just shorted a European call option.
   - To protect from negative payoffs on short call, we buy a stock.
   - This combination of long stock and short call is "writing a covered call".



Trading Option and Underlying Asset

1. Writing a covered call



- The profit pattern looks similar to short position in a put option. This makes sense, because

$$S_0 - c_0 = Ke^{-rT} - p_0$$

from the put-call parity.

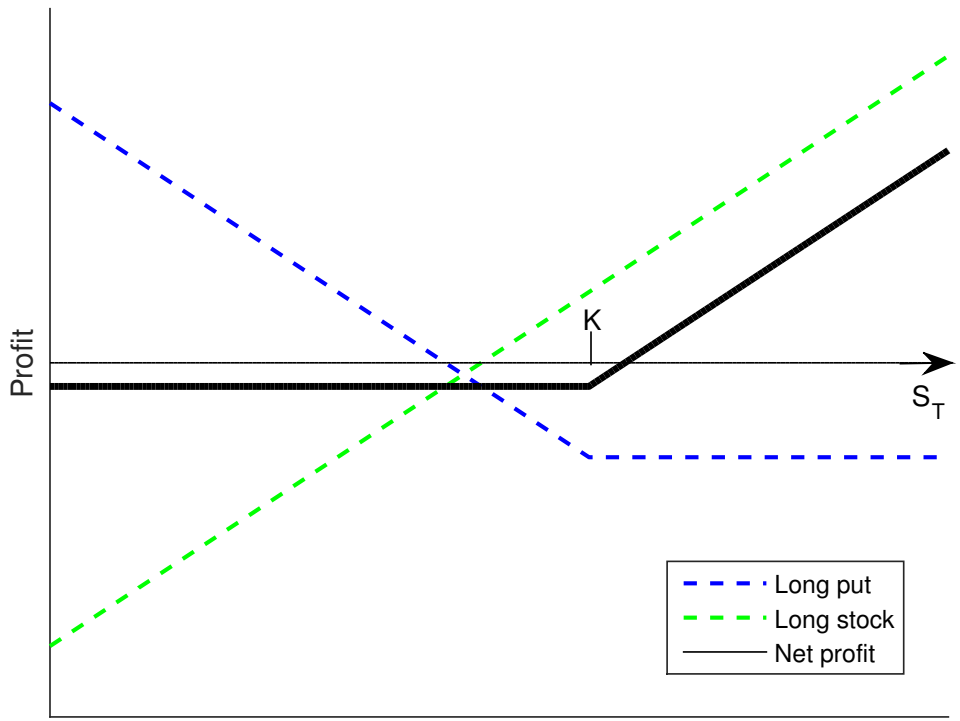
Trading Option and Underlying Asset - Example

- This practice of writing a covered call is considered one of the contributors to the recent price surge of US tech stocks.
- A WSJ article
  - Small investors bought call options with roughly $500 billion of notional value in August . . . five times the previous monthly high . . .
  - Option buying is important partly because it forces Wall Street banks, which sell options to investors, to hedge their positions, potentially accelerating trends in either direction.
  - When brokers sell call option to investors, they will buy shares and derivatives to protect themselves if the market soars. That act itself can drive up shares.

Trading Option and Underlying Asset

2. Protective put

   - This consists of a long position in a stock and a long position in a European put.
   - This protects an investor from big drops in the stock price.



Trading Option and Underlying Asset - Example

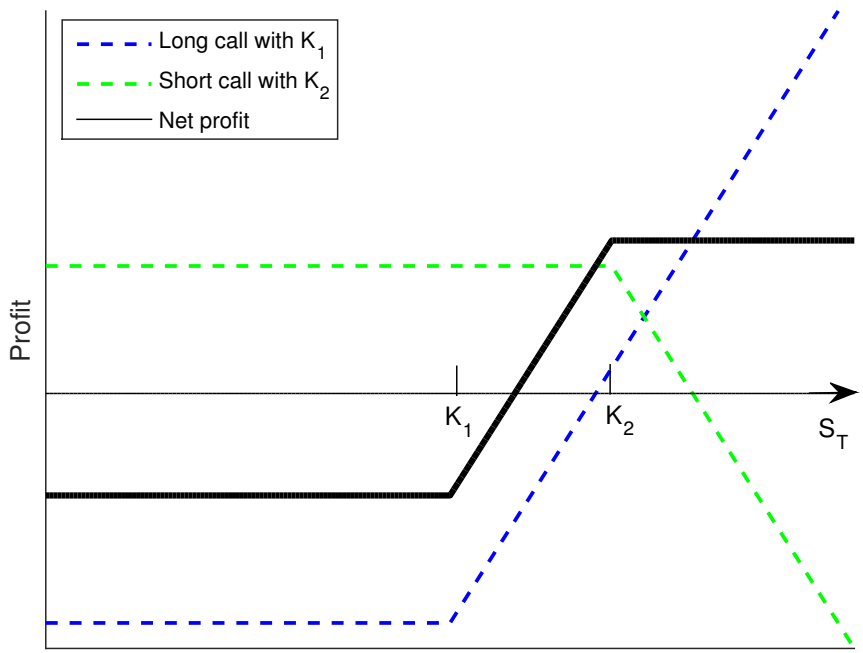
- A fund manager is long a stock with price S and it is worried about S declining. Consider 2 strategies:
  - It can hedge the risk by shorting a forward or futures contract on S with delivery price K.
  - It can insure against the risk by buying a put option.
- In this case, the option is really an insurance contract
- As with any insurance contract, it costs money upfront to purchase options (the option premium)
- By contrast, it costs nothing to enter the forward contract

Spreads - Bull Spreads

- Spreads involve two or more options of the same type (call or put).

- Bull spreads

  - This consists of buying a European call option with the strike price ITM K_1 and selling a European call option with the strike price OTM $K_2 (> K_1)$. The two options have the same expiration dates.



Spreads - Bull Spreads

- Bull spreads
  - Payoff at expiration

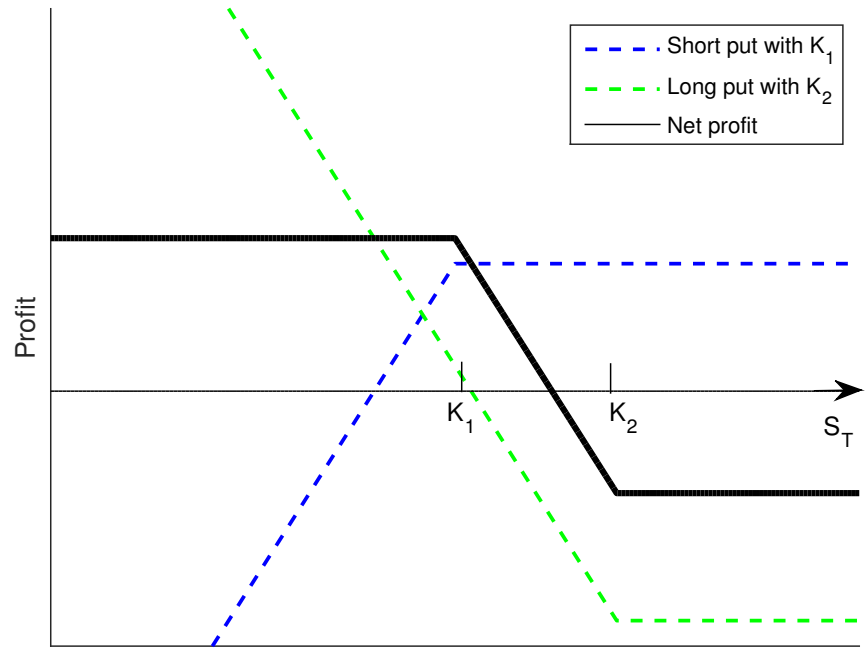
Action	Payoff at time T		
	$S_T \geq K_2$	$K_2 > S_T \geq K_1$	$K_1 > S_T$
long call with K_1	$S_T - K_1$	$S_T - K_1$	0
short call with K_2	$-(S_T - K_2)$	0	0
Net	$K_2 - K_1$	$S_T - K_1$	0

  - Note that the price of option with K_1 is higher than the price of option with K_2. Thus, this strategy requires an initial investment.

  - Using this strategy, the investor gives up some upside potential of long call with K_1. In return, the investor gets the price of the option with K_2.

Spreads - Bear Spreads

- Bear spreads
  - This consists of selling a European put option with the strike price OTM K_1 and buying a European put option with the strike price ITM $K_2 (> K_1)$. The two options have the same expiration dates.



Spreads - Bear Spreads

- Bear spreads
  - Payoff at expiration

Action	Payoff at time T		
	$S_T \geq K_2$	$K_2 > S_T \geq K_1$	$K_1 > S_T$
short put with K_1	0	0	$-(K_1 - S_T)$
long put with K_2	0	$K_2 - S_T$	$K_2 - S_T$
Net	0	$K_2 - S_T$	$K_2 - K_1$

  - Note that the price of option with K_2 is higher than the price of option with K_1. Thus, this strategy requires initial investment.

  - Using this strategy, the investor gives up some potential profit of long put with K_2. In return, the investor gets the price of the option with K_1.

Spreads - Example

Q. An investor expects the S&P500 to decrease in the future, so she wants to create a bear spread. She sees two 1-year European call options on the index; one with $K = 1,900$ is priced at \$130 and the other with $K = 2,000$ is priced at \$50. What should be her trading strategy? Find the profit at the option expiration.

Spreads - Example

Q. An investor expects the S&P500 to decrease in the future, so she wants to create a bear spread. She sees two 1-year European call options on the index; one with $K = 1,900$ is priced at \$130 and the other with $K = 2,000$ is priced at \$50. What should be her trading strategy? Find the profit at the option expiration.

Answer: To create a bear spread will call options, the investor should buy one with a higher strike price and sell the other. Then the initial cash flow from option transaction is 130-50=\$80.

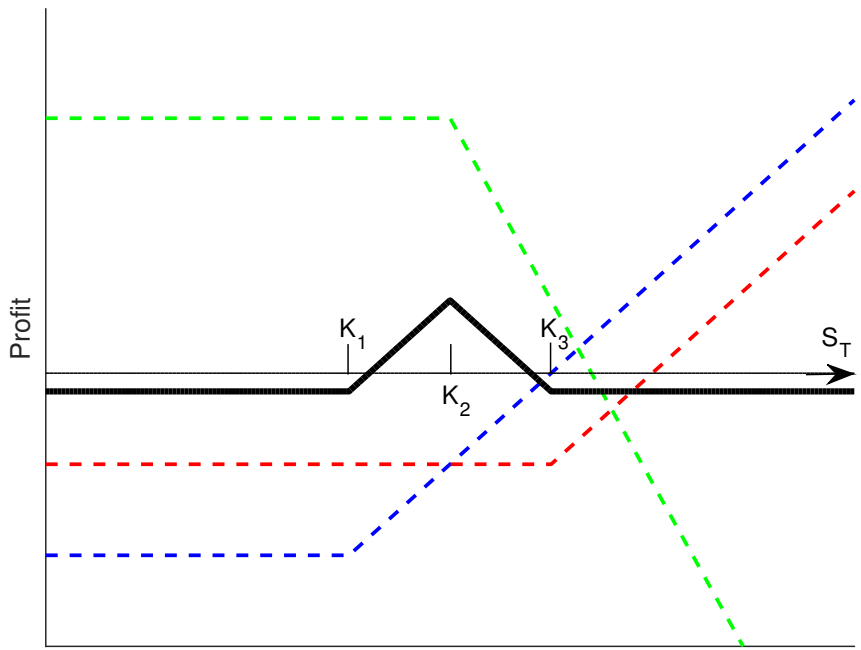
Profit at maturity is

Action	Payoff at time T		
	$S_T \geq 2,000$	$2,000 > S_T \geq 1,900$	$1,900 > S_T$
long call with $K = 2,000$	$S_T - 2000$	0	0
short call with $K = 1,900$	$-(S_T - 1900)$	$-(S_T - 1900)$	0
Net Payoff	-100	$-S_T + 1900$	0
Profit	-20	$-S_T + 1980$	80

Spreads - Butterfly Spreads

- Butterfly spread is a strategy where profit is maximized at a certain stock price. This is appropriate for investors who believe that large stock price moves are unlikely.

- To create, we buy a European call with strike price of K_1, buy a European call with K_3, and sell two European calls with K_2, where $K_1 < K_2 < K_3$. All options have the same expiration dates.



Spreads - Butterfly Spreads

- Payoff at expiration (assuming that $K_2 = 0.5(K_1 + K_3)$)

Action	Payoff at time T			
	$S_T \geq K_3$	$K_3 > S_T \geq K_2$	$K_2 > S_T \geq K_1$	$K_1 > S_T$
long call with K_1	$S_T - K_1$	$S_T - K_1$	$S_T - K_1$	0
long call with K_3	$S_T - K_3$	0	0	0
short 2 calls with K_2	$-2(S_T - K_2)$	$-2(S_T - K_2)$	0	0
net payoff	$\underbrace{2K_2 - K_1 - K_3}_{=0}$	$\underbrace{-S_T + 2K_2 - K_1}_{=-S_T+K_3}$	$S_T - K_1$	0

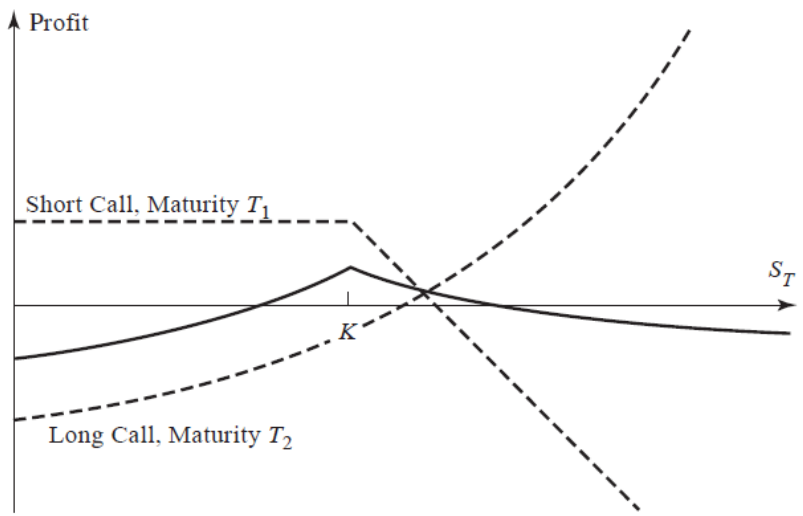
- The butterfly spreads can also be created using puts (buying a put with K_1, buying a put with K_3 and selling two puts with K_2.)

Spreads - Calendar Spreads

- Calendar spreads consist of European options with the same strike price K and different expiration dates.

- To create, we sell a European call with maturity T_1 and buy a European call with maturity $T_2 (> T_1)$.

Figure 11.8 Profit from calendar spread created using two call options, calculated at the time when the short-maturity call option expires.



Spreads - Calendar Spreads

- We start off with $c_0(T_1) - c_0(T_2)$ at t=0.
- At T_1, T_1-call is expired. The resulting payoff at T_1 is

$$-\max(S_{T_1} - K, 0) + c_{T_1}(T_2)$$

  where $c_{T_1}(T_2)$ is the price of T_2-call at T_1.
- Usually, a longer-maturity call option has a higher price, so this strategy requires an initial investment.
- The investor makes profit when stock price is close to K. This pattern is similar to the butterfly spreads.

Spreads - Calendar Spreads - Example

- An investor started a calendar spread in October 2019 with a short position in 1-year European call and a long position in 2-year European call. Both calls are on the same non-dividend-paying stock and have the strike price of \$120. At that time, the price of 1-year call was \$5 and the price of 2-year call was \$8. One year has passed, and the investor is now about to close all of the positions. The current stock price is \$150 and the risk-free interest rate is 3% per annum. What is smallest and largest possible profit from this calendar spread?

Spreads - Calendar Spreads - Example

- The cash flow in October 2020 is

$$-\max(150-120,0)+c_t(\text{Oct 2021})$$

where the first is payoff for the short position in the 2020-call and $c_t(\text{Oct 2021})$ is the price of the 2021-call in October 2020. As the 2021-call will expire one year later, its price should be

$$\underbrace{\max(150-120e^{-0.03\times 1},0)}_{=33.547}\leq c_t(\text{Oct 2021})\leq 150$$

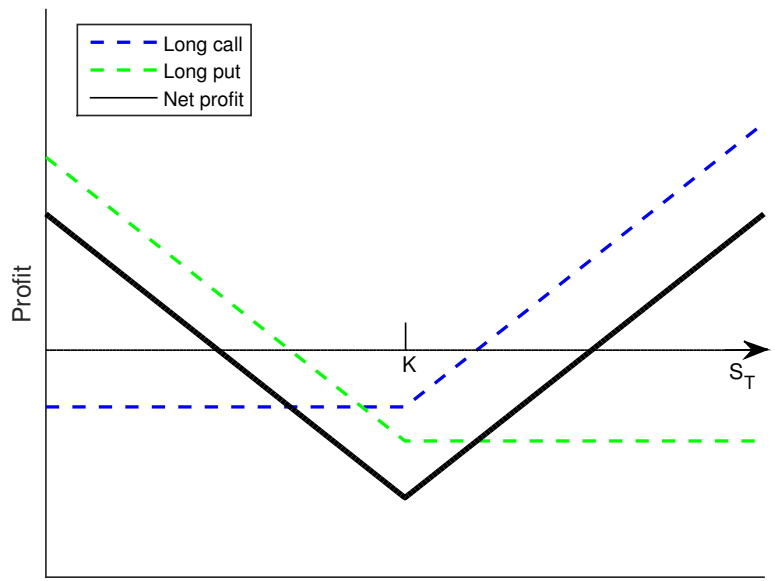
using the lower/upper bound for the call price. Including initial cash flows, the profit is $-30+c_t(\text{Oct 2021})+5-8$. Thus, the profit should be

$$0.547\leq \underbrace{-30+c_t(\text{Oct 2021})+5-8}_{=\text{profit}}\leq 117.$$

Combinations - Straddle

- A combination is a trading strategy that involves taking a position in both calls and puts.

- Straddle
  - This consists of buying a European call and a European put with the same strike price and expiration date.



  - This is appropriate for an investor who expects a large move in stock price but is uncertain about a direction.

Combinations - Straddle

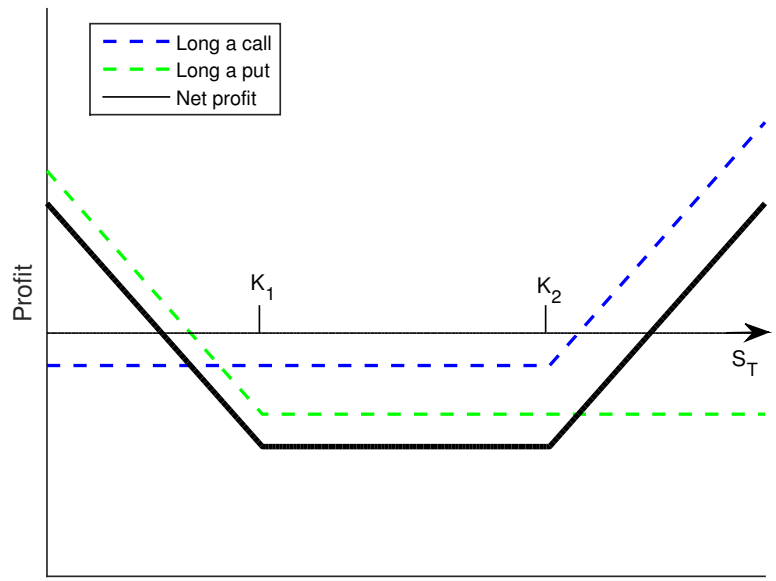
- Payoff at maturity

Action	Payoff at time T	
	$S_T \geq K$	$K > S_T$
long call	$S_T - K$	0
long put	0	$K - S_T$
Net	$S_T - K$	$K - S_T$

- Initially, an investor needs to pay option prices for both call and put.

Combinations - Strangle

- A disadvantage of straddle is that it requires a large initial investment to buy both call and put.
- Strangle is similar to straddle, but we buy cheaper call and put.
- In particular, we buy a European put with K_1 and a European call with $K_2 (> K_1)$.



Combinations - Strangle

- Payoff at maturity

Action	Payoff at time T		
	$S_T \geq K_2$	$K_2 > S_T \geq K_1$	$K_1 > S_T$
long call with K_2	$S_T - K_2$	0	0
long put with K_1	0	0	$K_1 - S_T$
Net	$S_T - K_2$	0	$K_1 - S_T$

- The profit structure is similar to straddle. However, the downside risk when the stock price does not move much is less than straddle.

Combinations - Strangle - Example

- An investor considers making a strangle using a European call and a European put. The call has the strike price of \$80 and currently sells for \$6. The put has the strike price of \$50 and currently sells for \$5. Both options have the expiration date T. Find the range of future stock price S_T where the profit is positive.

Combinations - Strangle - Example

- The profit of the strangle is as follows:

Action	Payoff at T		
	$S_T \geq 80$	$80 > S_T \geq 50$	$50 > S_T$
long 80-call	$S_T - 80$	0	0
long 50-put	0	0	$50 - S_T$
net payoff	$S_T - 80$	0	$50 - S_T$
initial cash flow	-11	-11	-11
net profit	$S_T - 91$	-11	$39 - S_T$

Thus, the profit is positive when $S_T > 91$ or $S_T < 39$.

Summary

- Principle-protected note: a zero-coupon bond and a European call option; for risk-averse investors
- A single option + underlying stock
  - Writing a covered call involves buying the stock and selling a call option on the stock
  - Protective put involves buying a put option and buying the stock
- Spreads
  - A bull spread can be created by buying a call (put) with a low strike price and selling a call (put) with a high strike price.
  - A bear spread can be created by buying a put (call) with a high strike price and selling a put (call) with a low strike price.

Summary

- A butterfly spread involves buying calls (puts) with a low and high strike price and selling two calls (puts) with some intermediate strike price.
- A calendar spread involves selling a call (put) with a short time to expiration and buying a call (put) with a longer time to expiration.
- Combinations involve taking a position in both calls and puts on the same stock.
  - A straddle combination involves taking a long position in a call and a long position in a put with the same strike price and expiration date.
  - A strangle consists of a long position in a call and a put with different strike prices and the same expiration date.