Options

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Calls

- A European **call** (on stock) confers the right, but not the obligation, to **acquire** one share of the underlying stock at a fixed, predetermined price (the strike price).
- Notation:
  t = time when the contract is entered into;
  T = time when the right can be exercised (maturity or expiration date);
  K = strike price (in $/share)
  c(t, T; K), sometimes simplified to c(T; K), c(T), or c(K), when the other arguments are implied.

Calls (2)

- An American call is like a European call, except that the option can exercised **anytime** from inception to expiration. Notation C(t, T; K), C(T;K), C(T), C(K).
- The holder of an option contract is the individual who can exercised the associated rights; s/he is **long** in the option. The individual who sold the right is **short** in the option. This is true for puts as well.

Puts

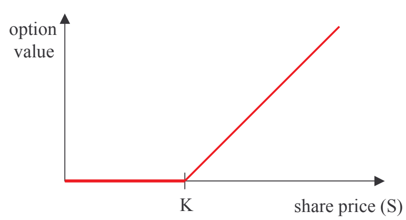
- A European **put** (on stock) confers the right, but not the obligation, to **sell** one share of the underlying stock at a fixed, predetermined price (the strike price).
- Notation:
  t = time when the contract is entered into;
  T = time when the right can be exercised (maturity or expiration date);
  K = strike price (in $/share)
  p(t, T; K), sometimes simplified to p(T; K), p(T), or p(K), when the other arguments are implied.

Puts (2)

- An American **put** is like a European call, except that the option can exercised **anytime** from inception to expiration. Notation P(t, T; K), P(T;K), P(T), P(K).

Payoff Diagrams at Expiration

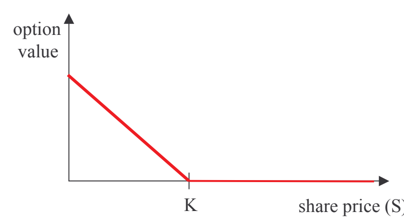
•Calls with strike K



The upside is potentially infinite. The payoff is always non-negative.

C(T)=c(T)=max(0, S(T)-K)

•Puts with strike K



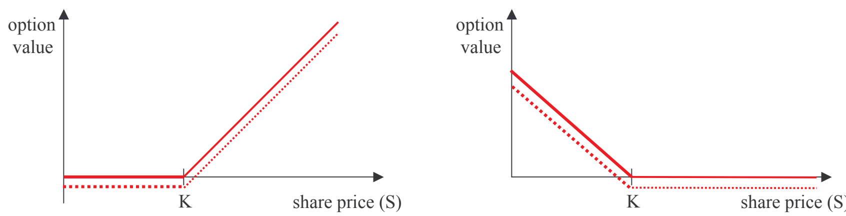
The upside is limited at K. The payoff is always non-negative.

P(T)=p(T)=max(K-S(T), 0)

Note: we ignore transaction costs!

Transaction Costs

•Calls with strike K •Puts with strike K



Transaction costs decrease the payoff by a constant amount.
One should still exercise the option if the share price is over K.

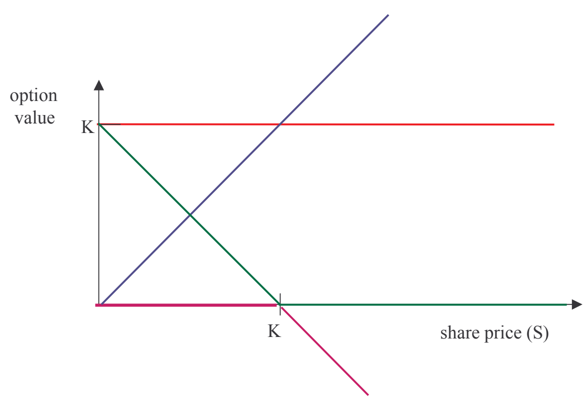
Market Players

- Several categories of players; they need each other to achieve their goals.
- **Hedgers**: want to protect their investment against adverse movements in the markets, and they are willing to pay for it, typically obtaining lower, but safer returns.
- **Speculators**: are willing to assume risk in order to achieve higher, but more variable returns. Sometimes they lose a lot.

Using Calls and Puts

- Market players can build portfolios of shares, calls, and puts that achieve their goals.
- We will continue to ignore transaction costs.
- As calls and puts expire, the portfolios lose their initial properties.

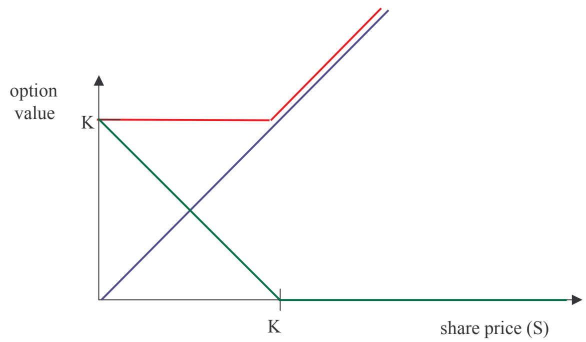
Indifference to Price Changes



S(T)+P(T,T;K)-C(T,T;K)

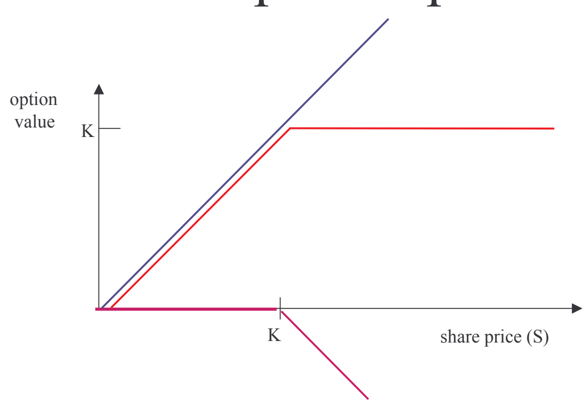
Note: At T, P(T,T;K) = p(T,T;K) and C(T,T;K)=c(T,T;K).

Insure Against Downside



S(T)+P(T,T;K)

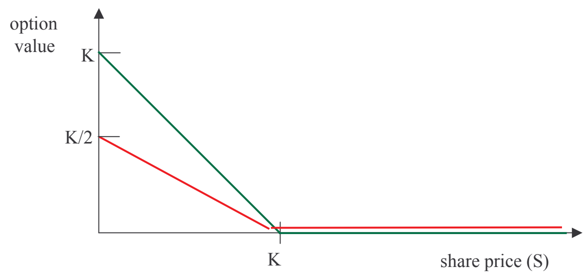
Give Up the Upside



S(T)-C(T,T;K)

What can induce a rational person to give up the upside potential?

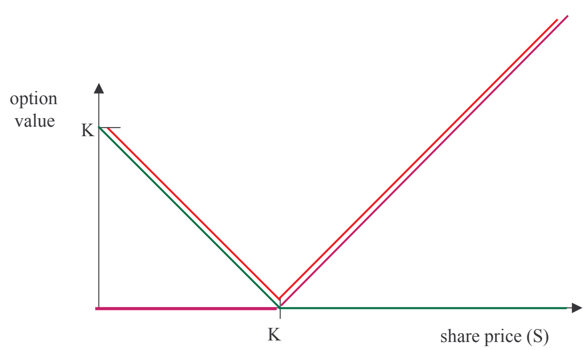
Not All Slopes Are Equal to ±1!



½P(T,T;K)

Does it make sense to even consider such situations?

Straddle



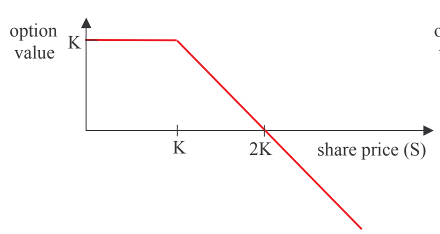
P(T, T; K)+C(T, T; K)

The profit increases as the stock price moves away from K.

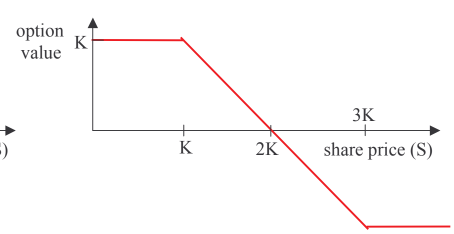
Payoffs &Traders' Market View

- Let us say that we have a definite view of the market. Say, we are pessimistic.
- If we know what will happen, we can always make money.
  Note 1: "Knowing" is really, really hard. We could say "hope" instead.
  Note 2: We need further assumptions.
- We want to make money if share prices go down.

The Pessimist's View



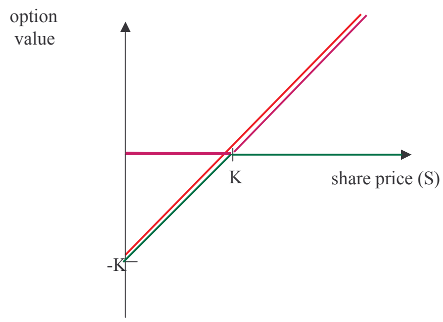
1. Makes money if prices are under K.
2. Payoff increases as S decreases.
3. Losses are **unlimited**.

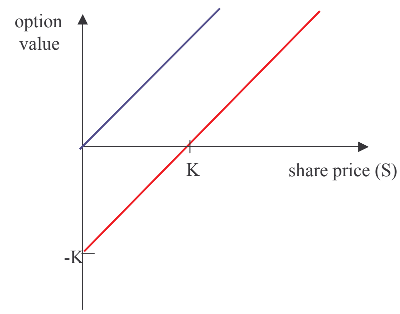


1. Makes money if prices are under K.
2. Payoff increases as S decreases.
3. Losses are limited.

Which contract would a risk-averse investor prefer?
Which payoff will be cheaper?
Write down the portfolios corresponding to these payoffs!

Put-Call Parity at T





C(T,T;K) - P(T,T;K) = S(T)-K

Reading Market Data

The cost of buying a call or a put is typically much less than the price of the underlying asset. This makes it easy to achieve **leveraged** positions. Can be dangerous!

Rank	Stock	Option	Option Symbol	Close	Change	Volume	Volume Change	Open Interest	Open Interest Change
1	INTC	MAR05 22.5 Put	NQOX.X	0.175	-0.05 (-22.2%)	41489	27633 (199.4%)	39393	7183 (22.3%)

After Hours (RT-ECN): 23.98 ↓0.01 (0.04%)

Last Trade:	23.99	Day's Range:	23.86 - 24.49
Trade Time:	Feb 28	52wk Range:	19.64 - 30.14
Change:	↓0.10 (0.42%)	Volume:	78,984,655
Prev Close:	24.09	Avg Vol (3m):	70,840,318
Open:	24.15	Market Cap:	149.39B
Bid:	22.10 x 200	P/E (ttm):	20.70
Ask:	24.25 x 1000	EPS (ttm):	1.16
1y Target Est:	27.68	Div & Yield:	0.32 (1.33%)

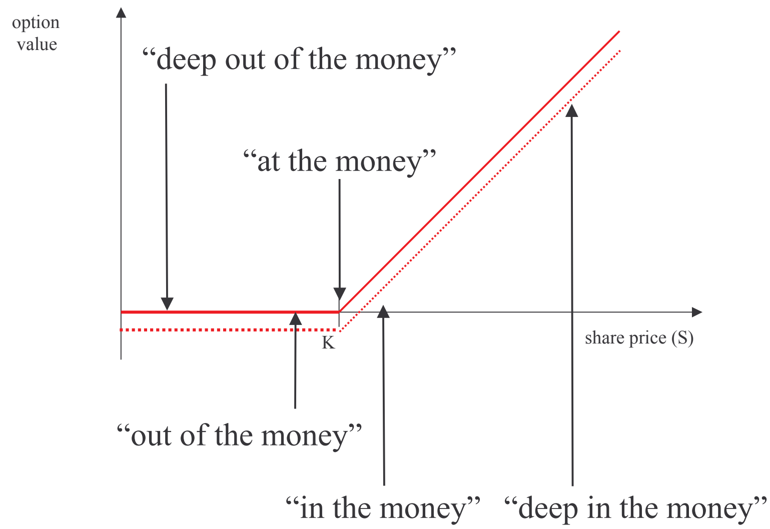
Options Markets

- This time we will not provide many details.
- Options are derivatives, their value depends on the value of another underlying instrument.
- Historically, people have been mostly interested in options on commodities.
- Options are traded OTC and on exchanges (since April 1973, on the CBOE).
- Options trading on exchanges are standardized. Why?

Options Markets (2)

- Only a relatively small set of delivery dates and strike prices are available at any time.
- Option contracts are written in multiples of 100 shares of the underlying stock.
- Delivery is usually not requested; payoffs are settled in cash.
- If one wishes to get out of an option contract, this can be done at any time by closing out the position (i.e. selling a c(t,T;K) if one is long in the same call).

In/Out of the Money



What’s an Option’s True Worth?

- We know the payoff at the expiration.
- We would like to know the value at inception and at any intermediate time t’ between t and T. The market price should equal the value of the option.
- Let us denote an arbitrary option by O. We must have that O(t, T; K) at time t’ has the same value as O(t’, T; K). Why?
  Options have no “memory,” i.e. the past (time < t) does not influence their value at time = t.
- We will thus only consider the value of O(t,T;K) at time t.