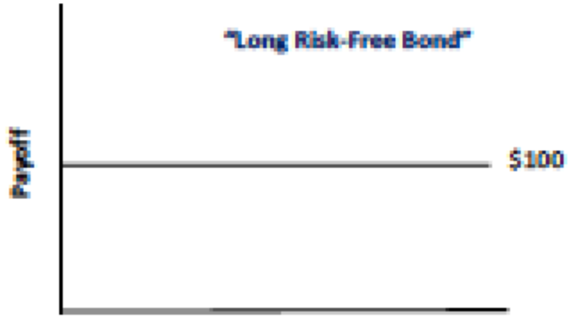
Lecture 5

Financial options

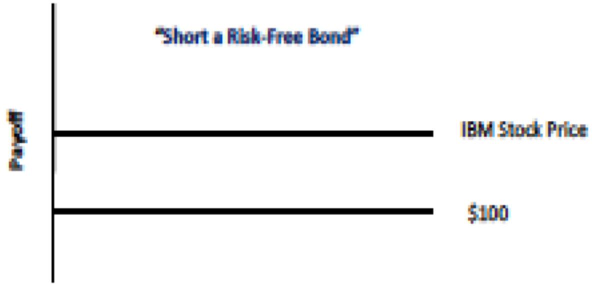
Basic Instruments

1. Bonds

- Long risk-free bond → buy

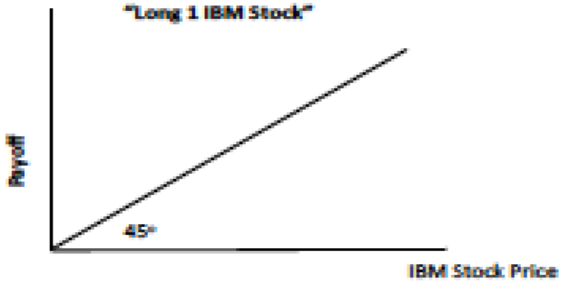


- Short risk-free bond → sell

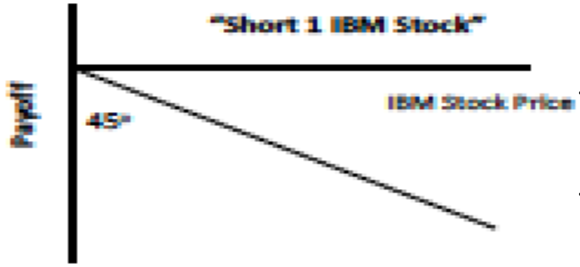


2. Stocks

- Long a Stock



- Short a Stock



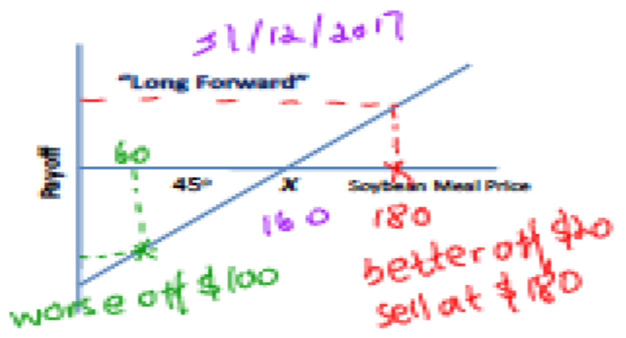
Mechanics of <u>Shorting a stock</u>:

- To short a stock, you first borrow it and then sell it
- When you have to return it, you buy it in the marketplace
- The stock is returned either when you close our your position, or you are forced by the lender to return it
- Cost of buy back = *gross pay-off = -S_T*

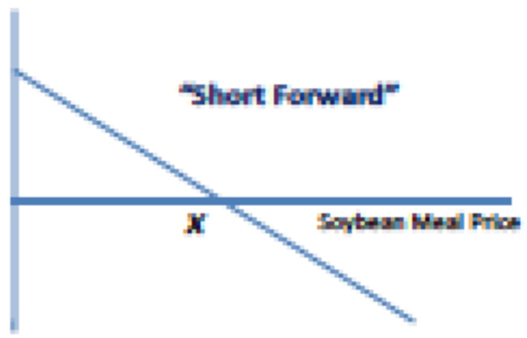
3. Forward/Futures Contracts

- <u>Forward contracts</u>: agreement between a buyer and a seller calling for delivery of a *specified amount* of a *specific asset* at a *specified (future) date*.
- Strike or exercise price → X

  Expiration date of the forward contract → T
- Long a Forward



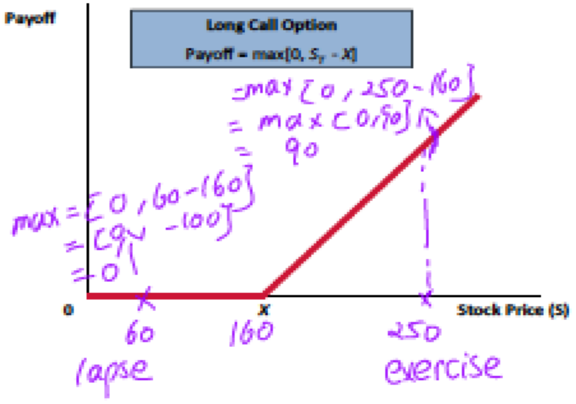
- Short a Forward



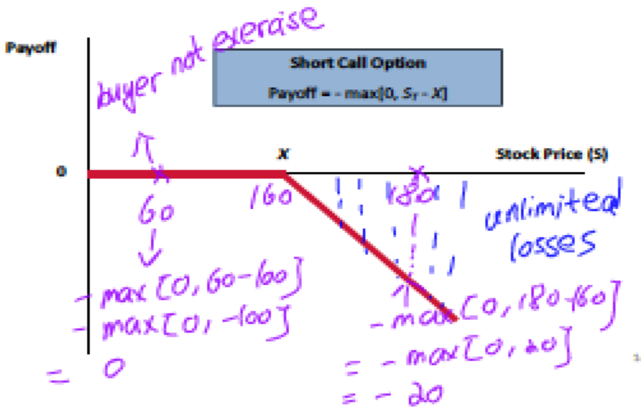
Options

- Call option: a contract that gives the buyer the right to *buy* the underlying security at a pre-specified price within a pre-specified period of time

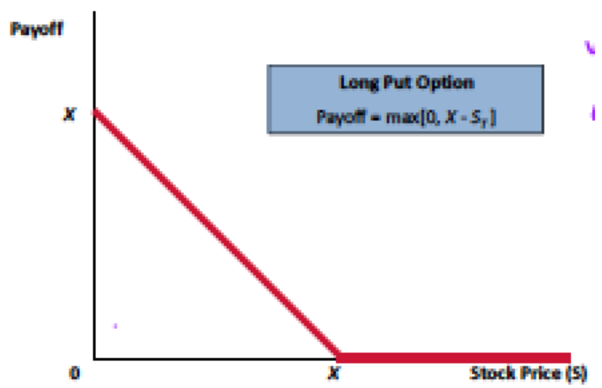
  - Buy Call Option



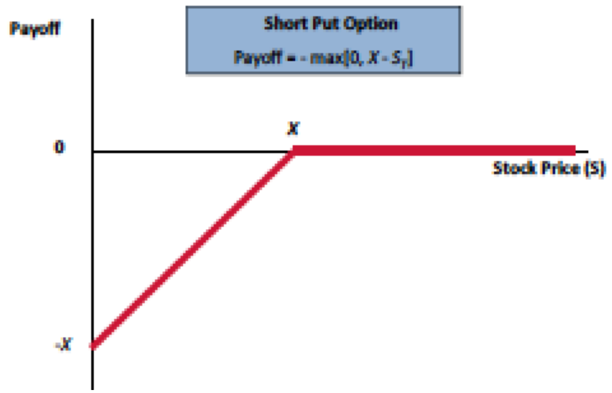
  - Sell Call Option



- **Put Option**: a contract that gives the buyer the right to *sell* the underlying security at a pre-specified price within a pre-specified period of time
  - Buy Put Option



  - Sell Put Option



Exercise styles

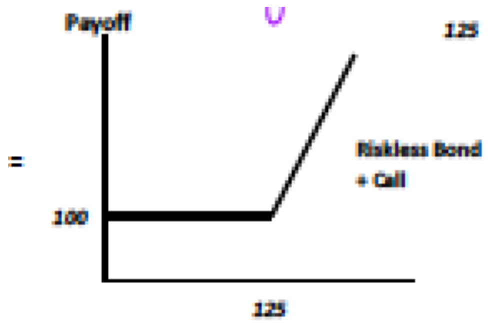
- European options (both calls and puts): only be exercised *on* the expiration date of the option
- American options (both calls and puts): may be exercised *on or before* the expiration date of the option →more exercise options →more expensive

Portfolios of Options

- Build a portfolio: stock + risk-free bond + call option on stock
- Example:

  - Suppose that you are long a risk-free coupon bond with a face value of $100 and a call option on CISCO stock with a strike price of $125. Graph the payoff from the portfolio as a function of CISCO's stock price.

	Stock Price	
Position	$0 \leq S_T \leq 125$	$125 \leq S_T \leq \infty$
Long Bond	$100	$100
Call option	0	S_T-125
Net position	$100	S_T-$25

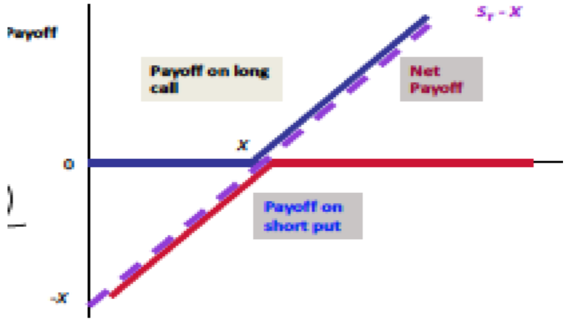


Put-Call Parity

- Example 1:

  - Suppose you buy a European call option and sell a European put option with a maturity date of T and an exercise price of X. How much will your options be worth at the end of T years?

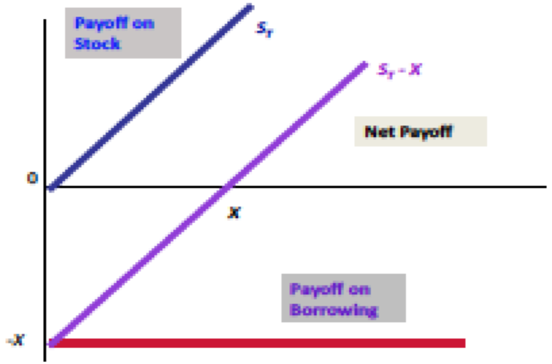
Position	0	T
Buy Call	$-C_E$	$\max[0, S_T - X]$
Sell Put	P_E	$-\max[0, X - S_T]$
Net position	$P_E - C_E$	$S_T - X$



- Example 2:

  - Now suppose you bought a share today for a price of S0 and simultaneously borrowed an amount of X(1+r)-T. How much would your portfolio be worth at the end of T years? Assume that the stock does not pay a dividend.

Position	0	T
Buy Stock	$-S_0$	S_T
Borrow	$PV = X(1+r)^{-T}$	$-X$
Net position	$X(1+r)^{-T} - S_0$	$S_T - X$



Lecture 6

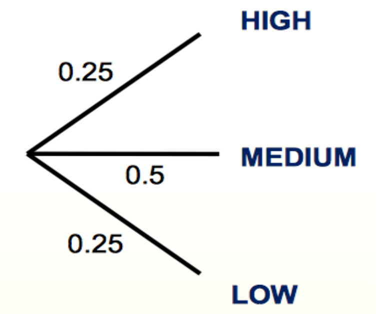
Real Options

- Expansion Options
- Timing Options
- Learning Options

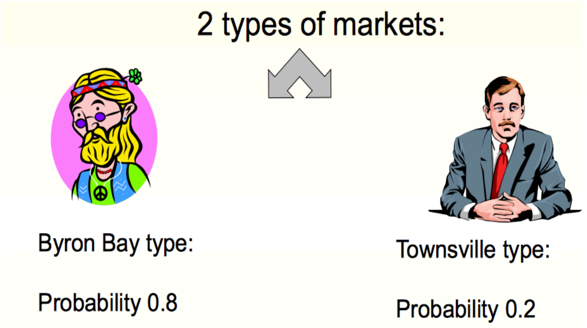
Net Present Value

You are considering opening a café in Brisbane.

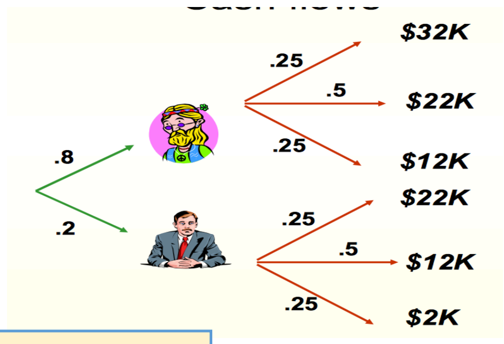
- **Risk 1: Level of demand**



- **Risk 2: Market risk**



Risks & Payoffs:



Assume:
- Initial investment = $100K
- CF continue for 10 years, starting year after initial investment
- $R_f = 2.1\%$; $r_m - r_f = 8.4\%$; $\beta = 1$ $\rightarrow discount\ rate = 2.1\% + 1 * 8.4\% = 10.5\%$

- $E[CF] = 0.8 * (0.25 * \$32 + 0.5 * \$22 + 0.25 * \$12) + 0.2 * (0.25 * \$22 + 0.5 * \$12 + 0.25 * \$2) = \$20K$
- $NPV_0 = -\$100 + 20 * \left[\frac{1-(1+10.5\%)^{-10}}{10.5\%}\right] = \$20.3$

- Opportunities → investing today/waiting and investing a year or two later → *call options* → have the right but not obligation to buy the stock before expiration date

DCF	Real Options
• *Static* (fixed conditions)	• *Dynamic* (changing conditions)
• *Deterministic* (uses a single forecast or limited treatment of uncertainty)	• *Probabilistic* (more complete consideration of uncertainty)
• Inflexible: ignores options (rely on single business case that ignores the flexibility)	• Flexible: captures options (incorporates a business plan that captures flexibility)

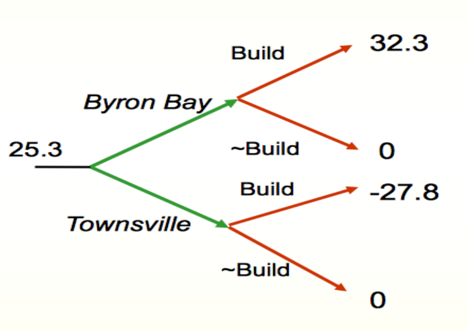
Idea: Pay for Information

Hire a marketing firm conduct a survey to determine if Brisbane = Byron Bay or Townsville?

- Assume that the research takes one year to complete: medium demand

- $PV_{Bryon\ Bay,1} = -100 + 22 * \left[\frac{1-(1+10.5\%)^{-10}}{10.5\%}\right] = \$32.3$
- $PV_{Townsvile,1} = -100 + 12 * \left[\frac{1-(1+10.5\%)^{-10}}{10.5\%}\right] = -\$27.8$
- $NPV_0 = \frac{0.8*\$32.3+0.2*0}{(1+2.1\%)^1} = \$25.3$
- How much are willing to pay for information:

$$NPV_{with\ info} - NPV_{without\ info} = \$25.3 - \$20.3 = \$5K$$



Assuming that market is like Bryon Bay and that the lease expires in 10

- Cost of waiting:
  - Almost all assets pay dividends (CF) → we may want to exercise real options sooner rather than later
  - $NPV_{Bryon\ Bay,1} = -100 + 22 * \left[\frac{1-(1+10.5\%)^{-9}}{10.5\%}\right] = \$24.2$
  - By delaying a year → give up one year CF: $NPV_{Bryon\ Bay,0} = \frac{0.8*\$24.2+0.2*0}{(1+2.1\%)^1} = \$19 < \$20.3 < \$25.3$
  - Uncertainties around research

Lecture 7

Forecasting Free Cash Flows

Free Cash Flow Definitions

Free cash flow to firm	Free cash flow to equity
Sales	Sales
- Costs (operating costs)	- Costs (operating costs)
= Gross profit	= Gross profit
- Depreciation and Amortization	- Depreciation and Amortization
= EBIT	= EBIT
+ Depreciation and Amortization	+ Depreciation and Amortization
- Capital expenditure	- Capital expenditure
- Change in working capital	- Change in working capital
- Increase in other assets	- Increase in other assets
- Decrease in other liabilities	- Decrease in other liabilities
= Free cash flow of firm	= Free cash flow of firm
	- Interest expenses
	- Preferred dividends
	- Principal repayments
	+ Proceeds with new debt issues
	= Free cash flow to equity

Claimholder	CF to claimholder	Discount rate
Equity holders	CF = SH distribution – change in additional paid in capital	Cost of equity
Debtholders	CF = interest expenses + principal repayments – new debt issues	Cost of debt
Preferred stockholders	CF = preferred dividends	Cost of preferred stocks
Total	CF = FCF to equity + interest expenses + principal repayments – new debt issues + preferred dividends	Weighted average cost of capital

Incremental Earnings
Sales
- COGS other than depreciation
- Depreciation
= EBIT
- Income tax
= Unlevered Net Income
+ Depreciation
- CAPEX
- Increase in NWC
= **FCF**

The Effect of Dilution at Maturity

- **Stock dilution** → value of conversion option < value of standard option on the stock
- To convert bonds to stock → V_{firm} is high enough for convertible bondholders
- **Price of option without conversion (P_{WOC}):**

$$P_{WOC} = \frac{V_{firm} - D}{N_{WOC}}$$

  - D = debt payment at maturity (FV+interest)
  - N_{WOC} = no. of shares into which convertible bonds convert

- Bondholders will convert *when* they **receive by converting > by holding debt**:

$$\rightarrow P_{AC} * N_C > D$$

$$\rightarrow P_{AC} > \frac{D}{N_C}$$

- P_{AC} should fall due to the dilution that occurs

> - Consider and all equity firm with a stock price of $50
> - N of shares outstanding = 1M
> - The firm issues 7,500 zero-coupon convertible bonds, face value of $1,000. The bond has a conversion ratio of 13.33
>   Conversion Price = 1,000/13.33 = $75

- When is it convenient to convert as a function of firm value?
  - The percentage of shares the convertible BH would get by converting:

$$\frac{N_C}{N_C + N_{WOC}} = \frac{7{,}500 * 13.33}{7{,}500 * 13.33 + 1m} = 9.09\% \text{ of the firm}$$

  - They will convert if 9.09% of the firm > value of their bonds:

$$9.09\% * V_{firm} > 7{,}500 * 1{,}000$$

$$V_{firm} > \$82.5m$$

> Suppose the value of the firm is $90M and the bondholders have not converted.

- Price without conversion (P_{WOC}) is: $\frac{\$90m - 7{,}500 * \$1{,}000}{1m} = \$82.50/share$
- Price after conversion (P_{AC}) is: $\frac{\$90m}{7{,}500 * 13.33 + 1m} = \$81.82/share$
- Dilution → difference between $82.5 and $81.82
- Convertible bondholders will get $\frac{7{,}500 * 13.33}{7{,}500 * 13.33 + 1m} = 9.1\%$ of all increases in V_{firm} above $82.5m