Option Basic

Financial Engineering and Computations

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Outline

- Introduction of Option
- Theory of Rational Option Pricing
- Put-Call Parity
- Option strategies

選擇權簡介(1)

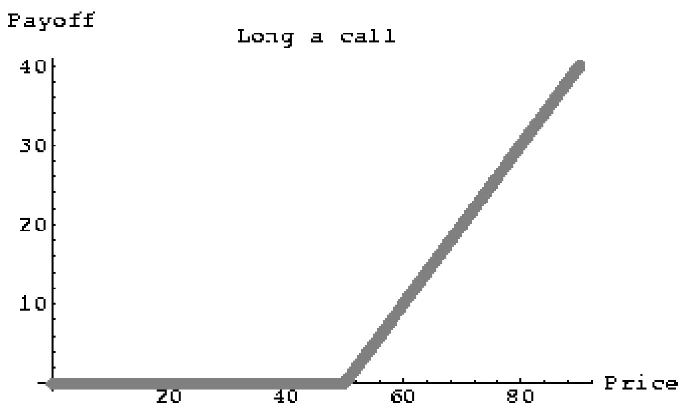
- 選擇權給予持有人在特定的時間點上,以約定好的價格,買入或賣出特定的資產的權利
  - 契約上載明的日期稱為到期日(maturity date)
    - 假定合約起始點為0,到期日為T
  - 交易的資產稱為標的資產(underlying asset)
    - 假定在時間t時,標的資產價格為S(t)
  - 契約上載明的價格稱為履約價格(exercise price)
    - 假定履約價格為X

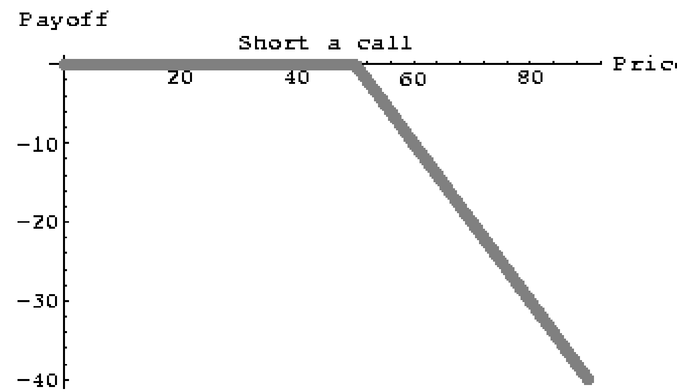
選擇權簡介(2)

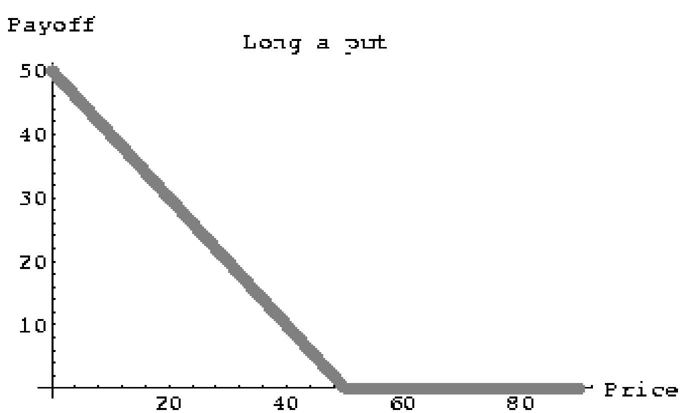
- 買權(call)給予持有人以X價格購買標的物權利
  - 到期日損益:max(S(T)-X,0)
  - 在到期日時,S(T)>X,持有人履約(exercise)
    - payoff=S(T)-X
  - 在到期日時,S(T)＜X,持有人放棄合約

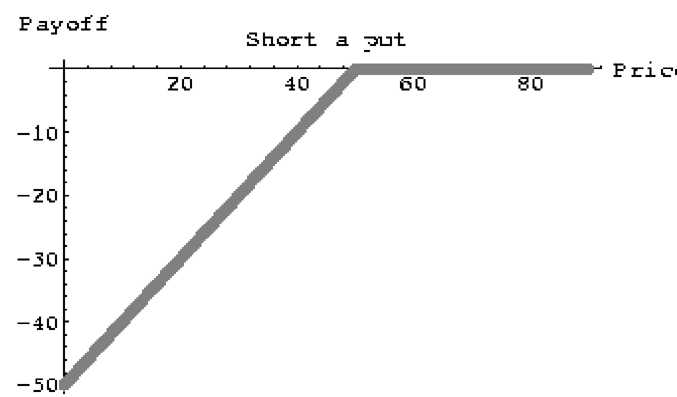
- 賣權(put)給予持有人以X價格售出標的物權利
  - 到期日損益:max(X-S(T),0)
- 購買選擇權的成本稱為權利金

Payoff
(假設無權利金，歐式選擇權)









Payoffs for European Options on Maturity

- Suppose that you have bought one European put and an European call on DELL with the same strike price of $55. The payoffs of your options certainly depend on the price of DELL on maturity

Stock Price	$30	40	50	60	70	80
Call Value	0	0	0	5	15	25
Put Value	25	15	5	0	0	0

選擇權的種類

- 歐式選擇權(European option)只能在到期日時才能決定是否履約
  - 前一頁的損益針對歐式選擇權
- 美式選擇權(American option)可在到期日之前履約
  - exercise at time t:
    - Call : S(t)-X
    - Put : X-S(t)
- 美式選擇權的權利金 >= 歐式選擇權

選擇權的價值

- 對選擇權買方而言，為了取得未來買進(賣出)的權利，自然必須付出代價，此代價便是選擇權的價值，也就是權利金(Premium)。

- 權利金和一般現貨市場的報價一樣，隨著買方與賣方願意支付與接受的情況，形成市場上的供需，當價格達到買賣雙方均能接受的條件時便可成交。

- 選擇權之權利金是由內含價值(Intrinsic value)與時間價值(time value)所組成

  －內含價值即是選擇權履約價格與現貨價格之差，時間價值則是權利金扣除內含價值的部分。

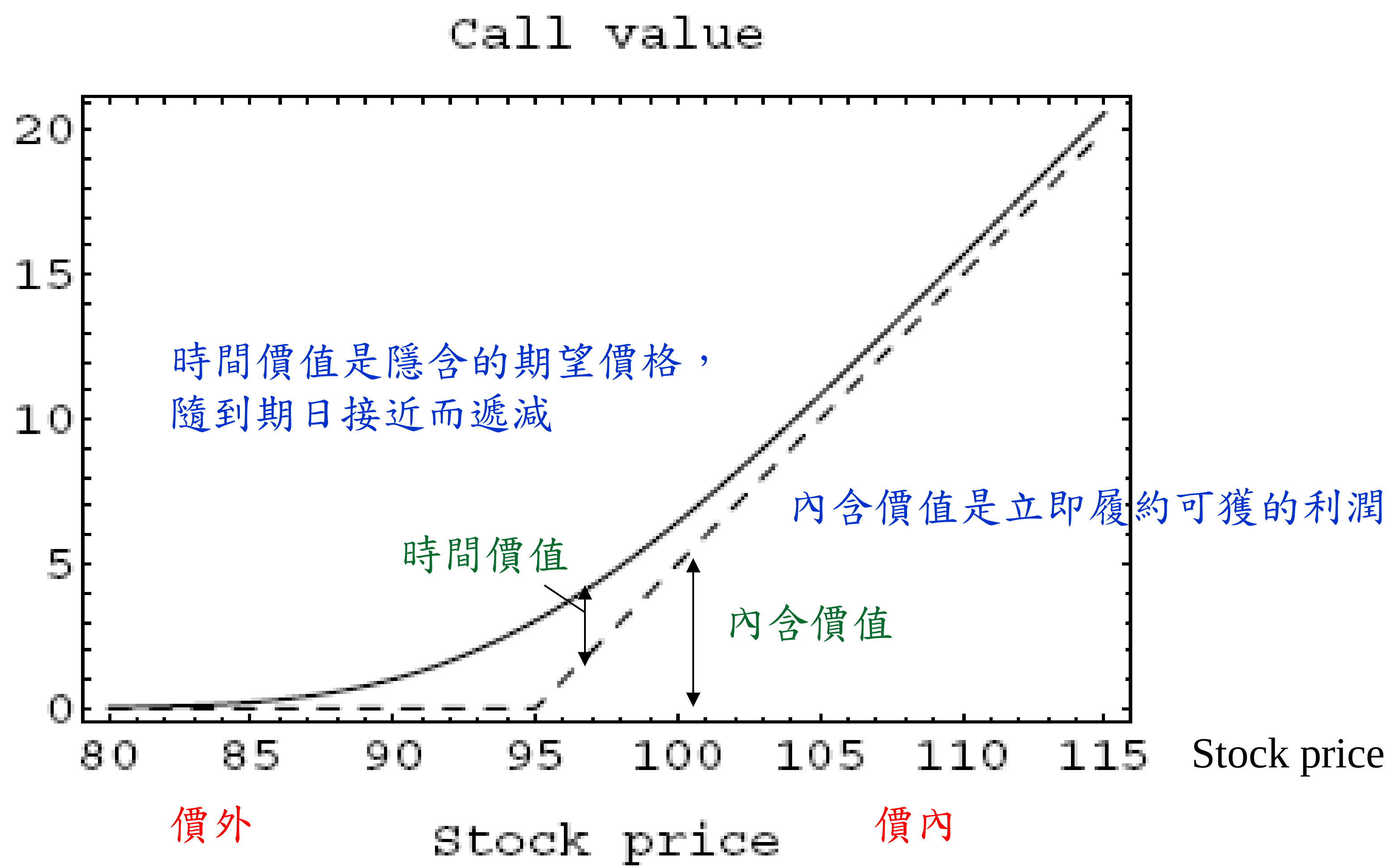
權利金(Premium) vs. 保證金(Margin)

- 權利金為選擇權之價值，與保證金不同。
- 賣方賣出選擇權之後，背負履約的義務，為保證到期能履行義務，故要求賣方繳存一定金額之保證金。
- 保證金繳交之對象：買權、賣權的賣方。
- 需進行每日結算，以控制違約風險。

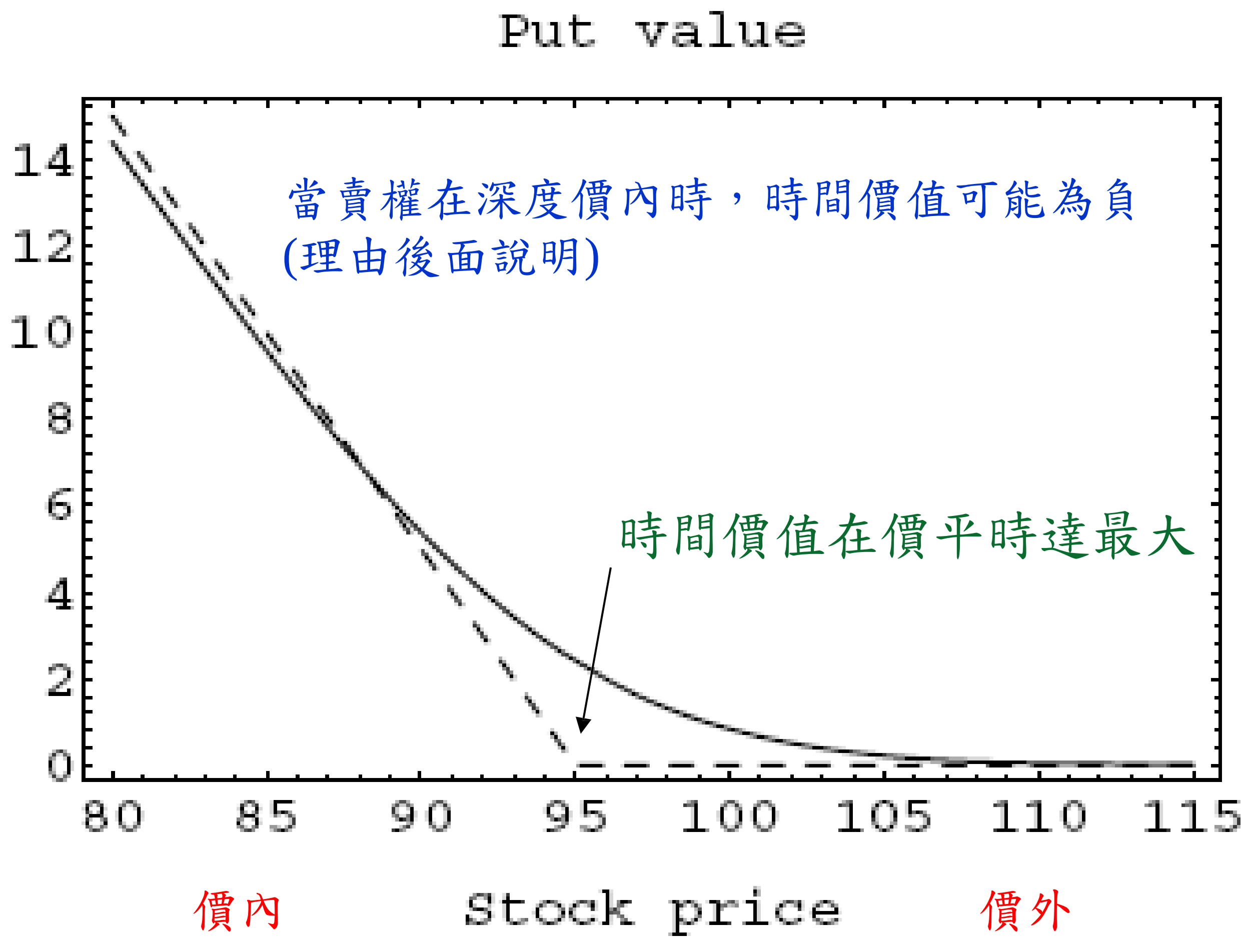
時間價值

- 影響時間價值的二個重要因素：到期日、標的物的價格波動率(下一章會詳細探討)。
- 接近到期日，時間價值遞減的速度愈快；在到期日時，時間價值降為零，只剩下內在價值的部分。
- 當時間價值減少時，獲利的是選擇權的賣方，因此在到期日接近時，反而對賣方有利。

Call Value
(Intrinsic value + time value)



Put Value
(Intrinsic value + time value)



Some Terminologies

- In the money
  - Call：S>X, Put：S<X
- At the money
  - Call, put：S=X
- Out of the money
  - Call：S<X, Put：S>X
- In the money options at expiration should be exercised.

影響選擇權價格的因素

	標的物價格	履約價格	無風險利率	到期期限	標的物價格波動率
Call	＋	—	＋	＋	＋
Put	—	＋	—	不一定	＋

(各因素影響的原因後面會詳細介紹)

波動性愈大的現貨，其選擇權的價格愈高。以向上波動而言，買權獲利無限而賣權損失有限；以向下波動來說，買權損失有限而賣權最大獲利為履約價格

Theory of Rational Option Pricing

- 以下將介紹幾個關於選擇權價格的重要定理，在這之前必須先了解兩個重要概念。
- No arbitrage and Dominance Principle
- Put-Call Parity

Notation

- S: Current stock price
- X: Strike price of option
- t: Time to expiration of option (unit: year)
- r: Continuously compound a year risk-free rate of interest
- C: value of American call option to buy one share
- c: value of European call option to buy one share
- P: value of American put option to buy one share
- p: value of European put option to buy one share

No arbitrage concept

- If two securities have the exactly the same payoff or cash flows in every state of each future period, these two securities should have the same price; otherwise there is an arbitrage opportunity.

Dominance Principle

- A risk-less arbitrage opportunity is one that, without any initial investment, generates nonnegative returns under all circumstances.
- The portfolio dominance principle says portfolio A should be more valuable than B if A's payoff is at least as good under all circumstances and better under some.

Put-Call Parity

- Let p(X,t) and c(X,t) be the prices of a European put and a call with same strike prices of X and maturity of t. Then we have

$$c(X,t) = S_0 + p(X,t) - Xe^{-rt}$$

Or

$$c(X,t) + Xe^{-rt} = S_0 + p(X,t)$$

若已知買權價格，透過賣買權平價理論可以推的賣權價格，不過有幾個重要前提必須成立：歐式選擇權、買賣權的履約價格與到期日均相同

Put-Call Parity (Proof)

$$c + PV(X) = p + S$$

在連續複利的假定下$PV(X)=Xe^{-rt}$

- Consider the following two portfolios.
- A: Buy one European call option plus an zero coupon bond amount of cash equal to PV(X) X is par value
- B: Buy one European put option plus one share stock.

	Initial cost	$S_t \geqq X$	$S_t < X$
A	c+PV(X)	$(S_t - X) + X = S_t$	X
B	p+S	S_t	$S_t + (X - S_t) = X$

未來的報酬均相同，在無套利的空間下，期初的投資成本應該要相同。

選擇權價格關係

- 選擇權的價格必須滿足特定的關係
  - 否則存在套利的空間
  - 例如:選擇權的價格>=0
    - Otherwise:
      - Long a option (Gain initial benefits.)
      - Exercise the option if it is beneficial.

Put-Call Futures Parity失效

Put-Call Futures Parity ：$C - P = F - K$

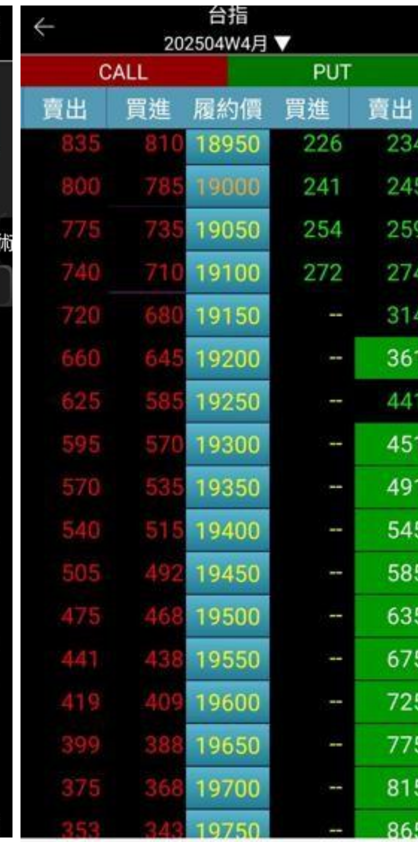
F漲停鎖死無法再往上漲

相對市場上沒有人願意買 Put

導致Put的 ask 跌停， bid 消失

Put的理論值完全失效

call受情緒推到高點超出模型範圍



CALL			PUT	
賣出	買進	履約價	買進	賣出
835	810	18950	226	234
800	785	19000	241	245
775	735	19050	254	259
740	710	19100	272	274
720	680	19150	--	314
660	645	19200	--	361
625	585	19250	--	441
595	570	19300	--	451
570	535	19350	--	491
540	515	19400	--	545
505	492	19450	--	585
475	468	19500	--	635
441	438	19550	--	675
419	409	19600	--	725
399	388	19650	--	775
375	368	19700	--	815
353	343	19750	--	865

此時市場出現流動性失效、價格鎖死、極端情緒干擾理論價格

Put-Call Futures Parity失效

若$C-P>F-K$理論上：short C、 long P 、 long F

若$C-P<F-K$理論上：long C 、short P 、 short F

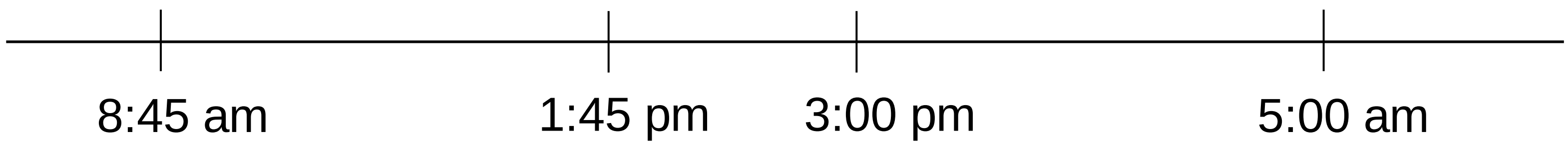
市場上 C−P≠F−K，進入一個「失去自由套利的封閉場域」

出現理論套利失效

理論套利失效（F漲停鎖死的價格無法真實反映真實理論價

同時Put有可能跌停，需推估理論價）：

Put-Call Futures Parity 理論價



漲跌停10%鎖死會在下午 3:00 夜盤開盤時重置

理論上，只要1:45pm-3:00pm 之間沒有出現任何重大消息

Futures and option價格不會出現劇變，藉由Put-Call Futures Parity

利用有流動性的 call、put 價格，推算期貨的理論價格 F

即 F=C-P+K，最後可以再利用Futures理論價

來回推其他選擇權的理論價格

Put-Call Futures Parity 理論價

							F漲停 18902		
Call Ask	Call Bid	Mid	K	Mid	Put Ask	Put Bid	F理論價=	C-P+K	Put理論價
835	810	822.5	18950	230	226	234		19542.5	
800	785	792.5	19000	243	241	245		19549.5	
775	735	755	19050	256.5	254	259		19548.5	
740	710	725	19100	273	272	274		19552	
720	680	700	19150	-	-	314			
660	645	652.5	19200	-	-	361			310
625	585	605	19250	-	-	441			
595	570	582.5	19300	-	-	451			340
570	535	552.5	19350	-	-	491			360
540	515	527.5	19400	-	-	545			385
505	492	498.5	19450	-	-	585			406
475	468	471.5	19500	-	-	635			429
441	438	439.5	19550	-	-	675			447
419	409	414	19600	-	-	725			472
399	388	393.5	19650	-	-	775			501
375	368	371.5	19700	-	-	815			529
353	343	348	19750	-	-	865			556

Put-Call Parity失效

市場上 C-P≠F-K，進入一個「失去自由套利的封閉場域」

出現理論套利失效

理論套利失效(F鎖死，Put跌停)：

若$C - P > F - K$理論上：short C、 long P 、 short F

若$C - P < F - K$理論上：long C 、 short P 、 long F

Maturity and Option Value

- ***Theorem1***

  An American call (put) with a longer time to expiration cannot be worth less than an otherwise identical call (put) with a shorter time to expiration

Proof

- Suppose instead that $C_{t1} > C_{t2}$ where $t_1 < t_2$.
- Buy C_{t2} and sell C_{t1} to generate a net cash flow of $C_{t1} - C_{t2}$ at time zero.
- Exercise C_{t2} when C_{t1} is exercised.
- Otherwise, sell C_{t2} at time t1.

Strike Price and Option Value

- ***Theorem2***

  A call (put) option with a higher (lower) strike price cannot be worth more than an otherwise identical call (put) with a lower (higher) strike price.

<u>Proof</u>

- Let the two strike prices be $X_1 < X_2$. Suppose $C_{X1} < C_{X2}$ instead.

maturity

Buy the C_{X1}
$+$
write the C_{X2}

$(S_t - X_1)$

$-(S_t - X_2)$

If holder exercise C_{X2}, then you exercise the C_{X1} at the same time

Cash inflow$=C_{X2} - C_{X1}$

Cash inflow$= X_2 - X_1 > 0$

台股指數選擇權

由此圖可看出履約價格與買(賣) 權的關係

月份: 2007/04 當天大盤收盤指數為7757

買權							賣權						
履約價	時間	成交價	買價	賣價	漲跌	總量	履約價	時間	成交價	買價	賣價	漲跌	總量
6900	09:55	**820**	820	835	▽15	11	6900	13:43	**9.1**	8.6	9.1	▽2.9	1674
7000	11:27	**740**	690	740	△5	9	7000	13:44	**12**	12	12.5	▽5	959
7100	11:30	**630**	630	645	▽10	22	7100	13:44	**18**	17	18	▽8.5	2125
7200	13:36	**550**	540	550	△5	48	7200	13:44	**25**	26	27	▽12	5237
7300	13:37	**470**	445	470	△13	72	7300	13:44	**38.5**	38.5	39.5	▽11.5	6776
7400	13:40	**397**	372	397	△17	105	7400	13:44	**55**	55	56	▽14	6650
7500	13:44	**307**	304	307	△3	158	7500	13:44	**78**	78	79	▽21	7271
7600	13:44	**235**	231	235	▽2	335	7600	13:44	**109**	109	110	▽22	4500
7700	13:44	**173**	173	174	▽3	1816	7700	13:44	**148**	148	149	▽22	4786
7800	13:44	**120**	120	121	▽9	6088	7800	13:44	**194**	195	196	▽21	1043
7900	13:44	**79**	80	81	▽8	10637	7900	13:44	**258**	250	258	▽32	173
8000	13:44	**48.5**	48.5	49	▽6.5	13697	8000	13:28	**323**	323	332	▽33	175
8200	13:44	**15.5**	15.5	16.5	▽3	8519	8200	11:58	**493**	493	505	▽17	10
8400	13:41	**4.1**	4.1	4.2	▽0.6	1032	8400	—	—	—	—	—	—
8600	12:08	**1**	1	2	▽0.7	64	8600	08:47	**855**	825	855	▽15	7
8800	13:29	**0.6**	0.6	0.9	△0.1	27	8800	—	—	—	—	—	—

Upper bounds

- **Theorem3**

  A call is never worth more than the stock price, an American put is never worth more than the strike price, and a European put is never worth more than the PV of the strike price.

- If the call value exceeded the stock price, then we earn risk-less profit by longing stock & shorting call.
- If the put value exceeded the strike price, writing a cash-secured put earns arbitrage profits.

Intrinsic value and Call Value

- **Theorem4**

  A European call on a non-dividend-paying stock is never worth less than its intrinsic value, we prove
  c ≧ Max (S-PV(X), 0) instead

  See later slide

- **Theorem5**

  An American call on a non-dividend-paying stock will never be exercised prior to expiration, and hence, it has the same value as a European call.

  See later slide

Proof (Theorem4)

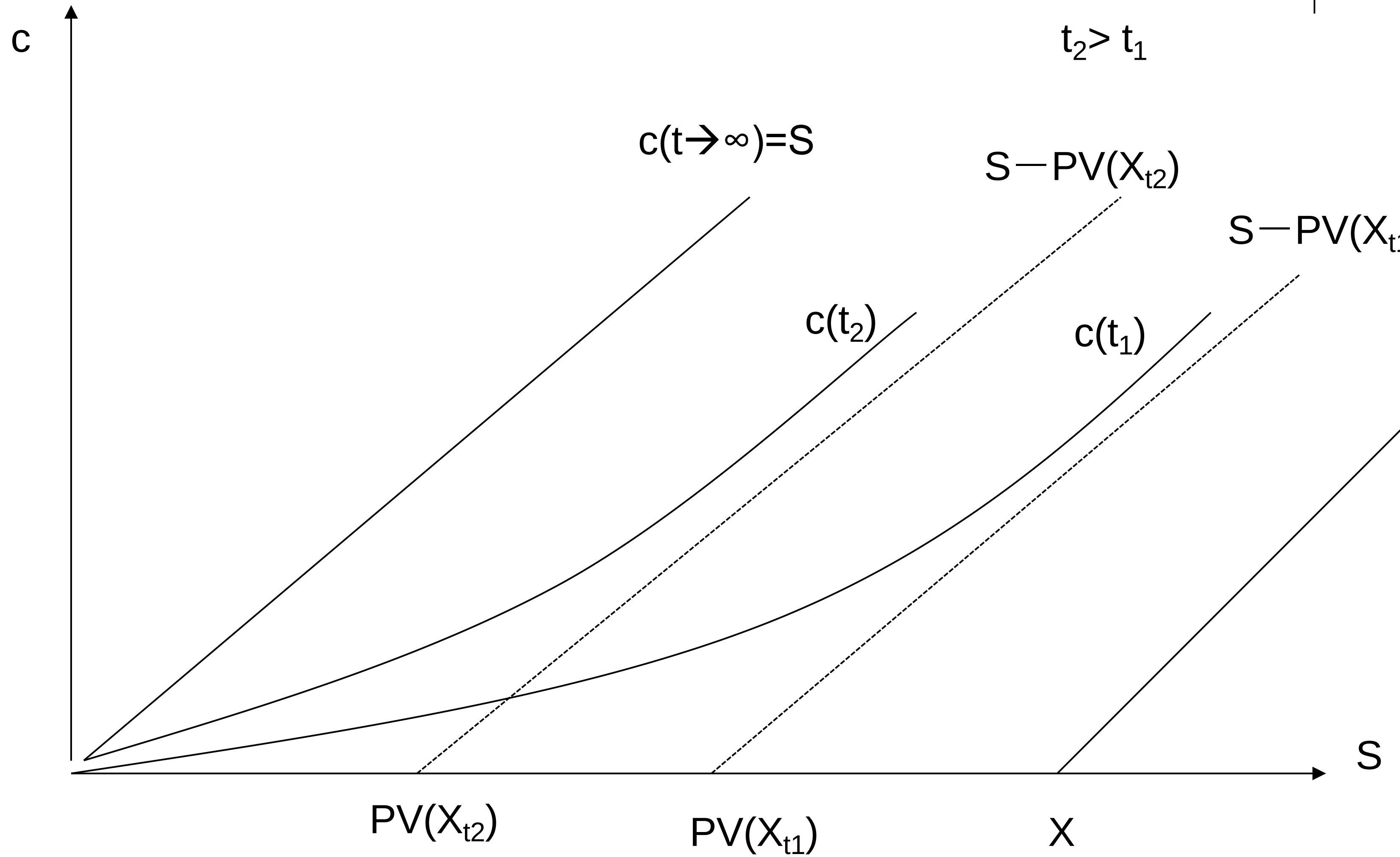
- Consider the following two investment:
- A: Buy the one European call for c Total investment: =c+ PV(X)

  Buy one zero bond at price PV(X)
- B: Buy the common stock for S Total investment: S
- Suppose at the end of t years, the common stock price is St.

	A	B	
St $\leqq$ X	X	S_t	A dominate B
St $>$ X	$(S_t-X)+X=S_t$	S_t	

By dominance principle, A will dominate B, c+ PV(X) $\geqq$S .
It implies that C $\geqq$Max (S-PV(X), 0)

Call (different maturity)



Proof(Theorem5)

- From Theorem 4, $c \geqq \text{Max}(S\text{-}PV(X), 0)$, because the owner of an American call has all the exercise opportunities, we must have $C \geqq c$.

  → $C \geqq \text{Max}(S\text{-}PV(X), 0)$

- Given $r > 0$, it follows that $S - PV(X) > S - X$.
- If it were optimal to exercise early, $C = S - X$. We deduce it can never be optimal to exercise early.

Special Example : Dividend Case (Early Exercise of American Calls)

- Surprisingly, an American call will only be exercised at expiration or just before an ex-dividend date.
- Early exercise may become optimal for American calls on a dividend-paying stock.

  - Stock price declines as the stock goes ex-dividend.
- This point will be discussed further in next chapter.

Intrinsic value and Put Value

- **Theorem6**

  For European puts, ***p ≥ Max (PV(X) − S, 0)*****.**

- A European put on a non-dividend-paying stock may be worth less than its intrinsic value.
- Proof

$$\because c + PV(X) = p + S$$

$$\Rightarrow p = PV(X) - S + c \geq PV(X) - S$$

$$as\ the\ put\ goes\ deeper\ in\ the\ money, c \approx 0$$

$$\Rightarrow p \approx (X - S) + \left(PV(X) - X\right) < X - S$$

Early Exercise of American Puts

- **Theorem7**

It can be optimal to exercise an American put option on a non-dividend paying stock early. Besides

P ≥ Max (X − S, 0).

$$\text{As the put goes deeper in the money}, c \approx 0$$

$$p = PV(X) - S + c \approx (X - S) + \left(PV(X) - X\right) < X - S$$

The value to exercise the option immediately.

$$P = \max(\text{continuation value}, X - S, 0) \geq \max(X - S, 0)$$

Summary (Option Bounds)

(If no dividends)	Upper bounds	lower bounds
European call	S	max(S－PV(X),0)
American call	S	max(S－PV(X),0)
European put	PV(X)	max(PV(X) －S,0)
American put	X	max(X－S,0)

Convexity of Option Prices

- Theorem8

If C and P is a rationally determined American call and put price, then C and P is convex function of its exercise price (X)

$$\mathbf{C_{X2} \leq \omega C_{X1} + (1-\omega)\, C_{X3}}$$
$$\boldsymbol{P_{X2} \leq \omega P_{X1} + (1-\omega)\, P_{X3}}$$

three otherwise identical calls with strike prices $X_1 < X_2 < X_3$

where $\omega \equiv (X_3 - X_2)/(X_3 - X_1)$.

Remarks: The above arguments can also be applied to European options.

Robert C. Merton (1973)

Proof (1)

Assume $C_{X2} > \omega C_{X1} + (1-\omega)\, C_{X3}$

- Write C_{X2}, buy ωC_{X1}, and buy $(1-\omega)C_{X3}$ to generate a positive cash flow now.
- If the short call is not exercised before expiration, hold the calls until expiration.

	$S \le X_1$	$X_1 < S \le X_2$	$X_2 < S < X_3$	$X_3 \le S$
$-C_{X_2}$	0	0	$X_2 - S$	$X_2 - S$
C_{X_1}	0	$\omega(S - X_1)$	$\omega(S - X_1)$	$\omega(S - X_1)$
C_{X_3}	0	0	0	$(1-\omega)(S - X_3)$
Net	0	$\omega(S - X_1)$	$\omega(S - X_1) + (X_2 - S)$	0

Proof (2)

- Suppose the short call is exercised early when the stock price is S.
- If $\omega C_{X1} + (1 - \omega)\, C_{X3} > S - X_2$, sell the long calls to generate positive net cash flow.

  $\omega C_{X1} + (1 - \omega)\, C_{X3} - (S - X_2) > 0.$

- Otherwise, exercise the long calls and deliver the stock.
- The net cash flow is $-\omega\, X_1 - (1 - \omega)\, X_3 + X_2 = 0.$

there is an arbitrage profit!

Class Exercise

利用下圖試著驗算theorem8 (eg. K=6900,7000,7100)

月份: 2007/04

買權						
履約價	時間	成交價	買價	賣價	漲跌	總量
6900		820	820	825	▽15	11
7000		740	735	740	△5	9
7100		630	630	635	▽10	22
7200		550	540	550	△5	48
7300		470	445	470	△13	72
7400		397	372	397	△17	105
7500		307	304	307	△3	158
7600		235	231	235	▽2	335
7700		173	173	174	▽3	1816
7800		120	120	121	▽9	6088
7900		79	80	81	▽8	10637
8000		48.5	48.5	49	▽6.5	13697
8200		15.5	15.5	16.5	▽3	8519
8400		4.1	4.1	4.2	▽0.6	1032
8600		1	1	2	▽0.7	64
8800		0.6	0.6	0.9	△0.1	27

假設上列為同一時間的報價

Portfolio Option

- **Theory9**

If k is a positive constant. Let C and C_Q *be two call options with the same underlying asset and maturity, If* $Q=kS$; $X_Q=kX$, *then we have* $C_Q=k\times C$

- **Theory10**

Consider a portfolio of non-dividend-paying assets with weights ωi. Let ci denote the price of a European call on asset i with strike price Xi. Then the call on the portfolio with a strike price $X\equiv\sum_i w_i X_i$ *has a value at most* $\sum_i w_i c_i$ *.All options expire on the same date.*

#Homework 9-1

- Prove Theorem 10.

Consider a portfolio of non-dividend-paying assets with weights ωi. Let ci denote the price of a European call on asset i with strike price Xi. Then the call on the portfolio with a strike price $X \equiv \sum_i w_i X_i$ *has a value at most .* $\sum_i w_i c_i$ *.All options expire on the same date.*

#Homework 9-2
The relationship between the future and the options prices

- Denote the prices for call and put options with strike price X and maturity T as Vc and Vp.
- Denote the price for the future matured at T as Vf
- Consider the following two strategies:
- 1: Long a call and short a put:
  - Initial payoff: Vp-Vc   At maturity: ST-X
- 2: Short a future: At maturity: Vf-ST
- Derive the relationship between Vp, Vc and Vf to avoid arbitrage

#Homework 10

- Write a program to scan the quotes in the S&P 500 index 、 S&P 500 future , and S&P 500 option index for arbitrage opportunities. (r=1.844%, maturity=1 month)

下載資料：標的物－S&P 500 index (https://www.investing.com/)

期貨－ S&P 500 future (https://www.investing.com/)

歐式選擇權－ S&P 500 option index (WRDS- OptionMetrics- Option Prices)

報價日期：2020-11-03

選擇權代號：108105

選擇權所需變數： Option ID、 Date、 cp_flag、 Exercise Style、 Index Flag

Exdate、 Last Date、 Security ID、 Volume、 Best Bid、

Best Offer、 Strike

檔案類型：*.txt檔

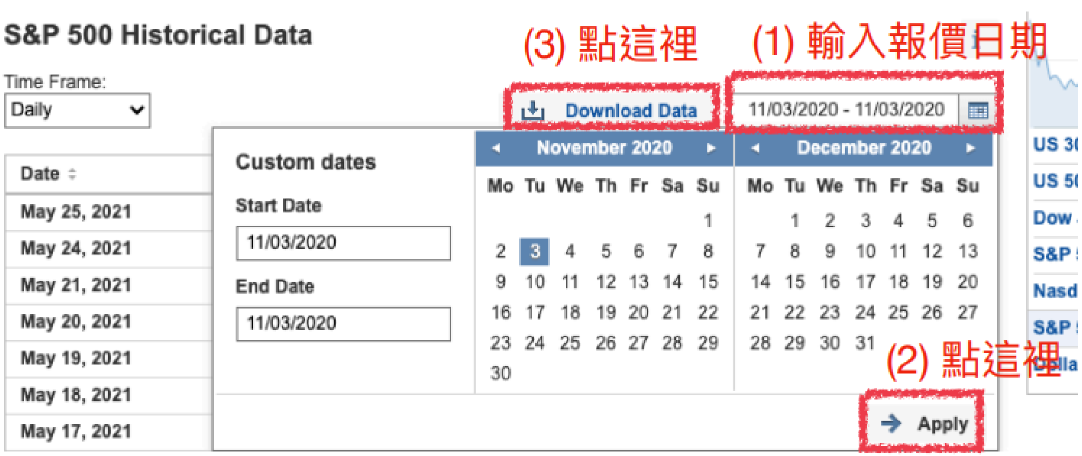
欄位說明

- **Option ID** : Option ID is a unique integer identifier for the option contract.
  This identifier can be used to track specific option contracts over time.
- **Date** : The date of this price
- **CP_flag** : C – Call , P – Put
- **Exercise Style** : A – American , E – European , ? – Unknown or not yet classified
- **Index Flag** : This flag indicates whether the security is an index. It is set to ‘1’
  if the security is an index and to ‘0’ otherwise
- **Exdate** : The expiration date of the option
- **Last Trade Date** : The date on which the option last traded
- **Security** ID : The Security ID for the underlying security
- **Volume** : The total volume of option contracts
- **Best Bid** : The best, or highest bid price across all exchanges on which the option trades.
- **Best Offer** : The best, or lowest ask price across all exchanges on which the option trades.
- **Strike** : The strike price of the option times 1000

下載S&P 500 future & S&P 500 index

在列表搜尋S&P 500 future & S&P 500 index，並點選 Historical data

選擇日期並下載資料



成功的話資料會長這樣

optionid	issuer	date	cp_flag	exercise_ style	index_ flag	exdate	last_ date	secid	best_bid	best_ offer	volume	strike_ price
134786452	CBOE S&P 500 INDEX	20201103	C	E	1	20201120	20201029	108105	3263.40	3268.70	0	100000
133142216	CBOE S&P 500 INDEX	20201103	C	E	1	20201120	20201023	108105	2364.00	2368.50	0	1000000
133142217	CBOE S&P 500 INDEX	20201103	C	E	1	20201120	20201019	108105	2264.10	2268.50	0	1100000
131109696	CBOE S&P 500 INDEX	20201103	C	E	1	20201120	20200805	108105	2164.20	2168.50	0	1200000
131109697	CBOE S&P 500 INDEX	20201103	C	E	1	20201120	20200603	108105	2064.20	2068.50	0	1300000
131109698	CBOE S&P 500 INDEX	20201103	C	E	1	20201120	.	108105	1964.40	1968.50	0	1400000
					⋮							
118538797	CBOE S&P 500 INDEX	20201103	C	E	1	20201218	20201102	108105	3255.80	3266.10	0	100000
118538798	CBOE S&P 500 INDEX	20201103	C	E	1	20201218	20201103	108105	2358.10	2366.20	400	1000000
118538799	CBOE S&P 500 INDEX	20201103	C	E	1	20201218	20200805	108105	2308.30	2316.20	0	1050000
118496961	CBOE S&P 500 INDEX	20201103	C	E	1	20201218	20200917	108105	2258.40	2266.20	0	1100000
127126708	CBOE S&P 500 INDEX	20201103	C	E	1	20201218	20200603	108105	2208.60	2216.20	0	1150000
118496962	CBOE S&P 500 INDEX	20201103	C	E	1	20201218	20200608	108105	2158.70	2166.30	0	1200000
					⋮							
118538812	CBOE S&P 500 INDEX	20201103	P	E	1	20201218	20201102	108105	0.00	0.05	0	100000
118538813	CBOE S&P 500 INDEX	20201103	P	E	1	20201218	20201103	108105	0.15	0.35	400	1000000
118538814	CBOE S&P 500 INDEX	20201103	P	E	1	20201218	20201029	108105	0.20	0.40	0	1050000
118497040	CBOE S&P 500 INDEX	20201103	P	E	1	20201218	20201030	108105	0.25	0.45	0	1100000
127126710	CBOE S&P 500 INDEX	20201103	P	E	1	20201218	20201029	108105	0.30	0.45	0	1150000
118497041	CBOE S&P 500 INDEX	20201103	P	E	1	20201218	20201030	108105	0.35	0.55	0	1200000

此報價日與後面期貨、
現貨例子的報價日相同

此到期日與後面期貨例子的到
期日相同 (12月的第三個禮拜五)

可以檢查選擇權的套利

#Homework 10

- Remark:
  - Assume that we can long/short S&P 500
  - Each point for S&P 500 index worth 1 USD
  - Each point for S&P 500 future worth 250 USD
  - Each point for S&P 500 option index worth 100 USD
  - All options are European ones
  - Transaction cost: 1 index-point per trade (applies to each open or close), converted to USD via the instrument's multiplier
  - Example: "Long Call + Short Put + Short Futures" costs

    Call: 1 pt × \$100/pt = \$100

    Put: 1 pt × \$100/pt = \$100

    Futures: 1 pt × \$250/pt = \$250
  - Total transaction cost = \$450

#Homework 10

- Remark:
  - Include transaction costs in all arbitrage calculations.
  - Program inputs: best-bid & best-ask for S&P 500 index, S&P 500 futures, and Call & Put at the same strike price K.
  - Program outputs: list of feasible arbitrage strategies and their net profits (after deducting transaction costs)
  - If both Put-Call Parity and Put-Call-Futures Parity arbitrage opportunities exist simultaneously, choose the strategy with the higher net profit.

選擇權的組合

- 選擇權和標的物可用不同形式組合(策略),組合出不同的損益
  - Hedge: Option +Underlying asset
  - Spread：同一類型的選擇權(只用call or put)
  - Combination：不同類型的選擇權。

Covered Position: Hedge

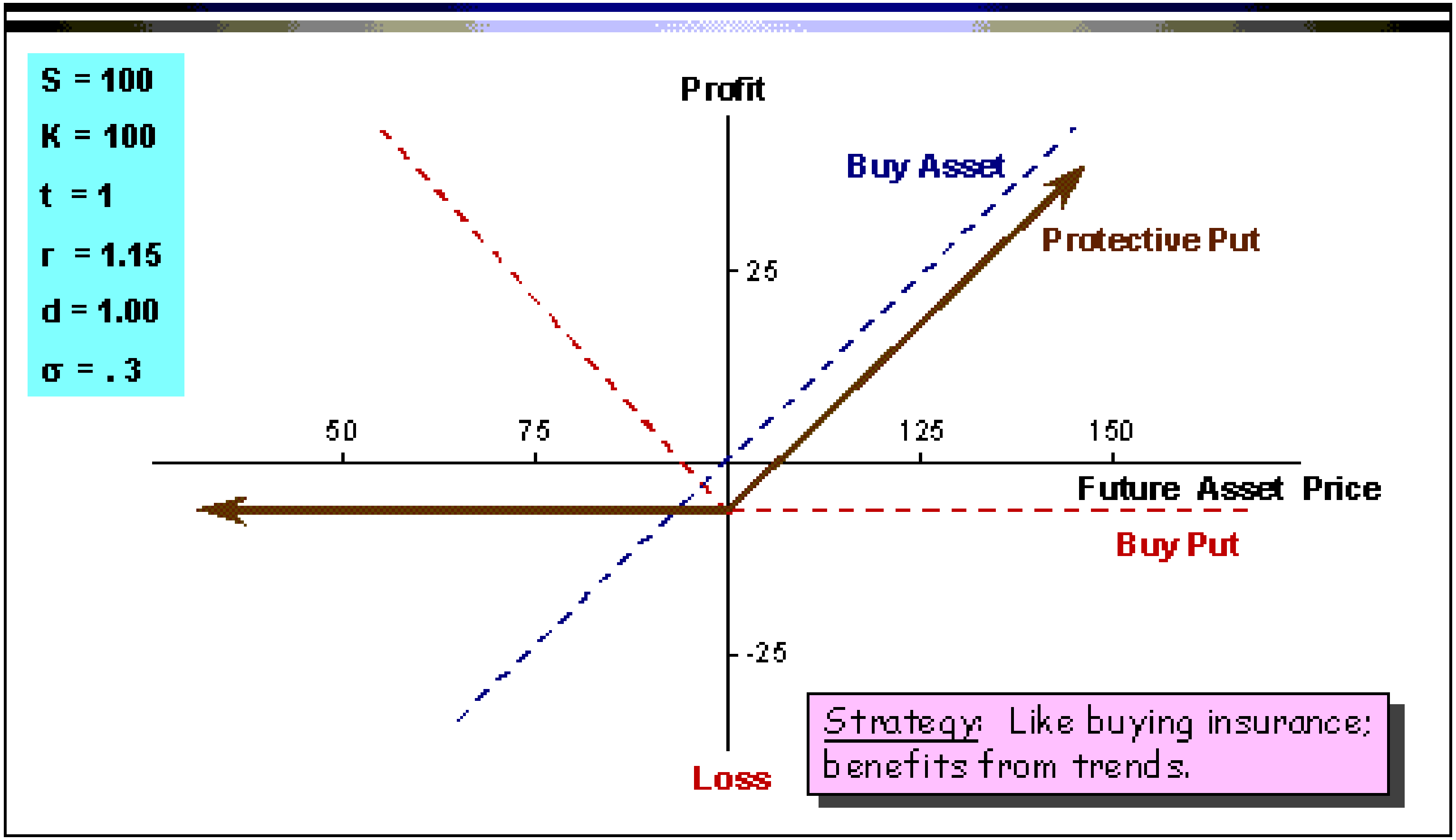
- A hedge combines an option with its underlying stock in such a way that one protects the other against loss.
- Protective put: A long position in stock with a long put.

 (Example：買進股票同時買進該股票的賣權，在股價下跌時，賣權的報酬可以彌補股票的損失)

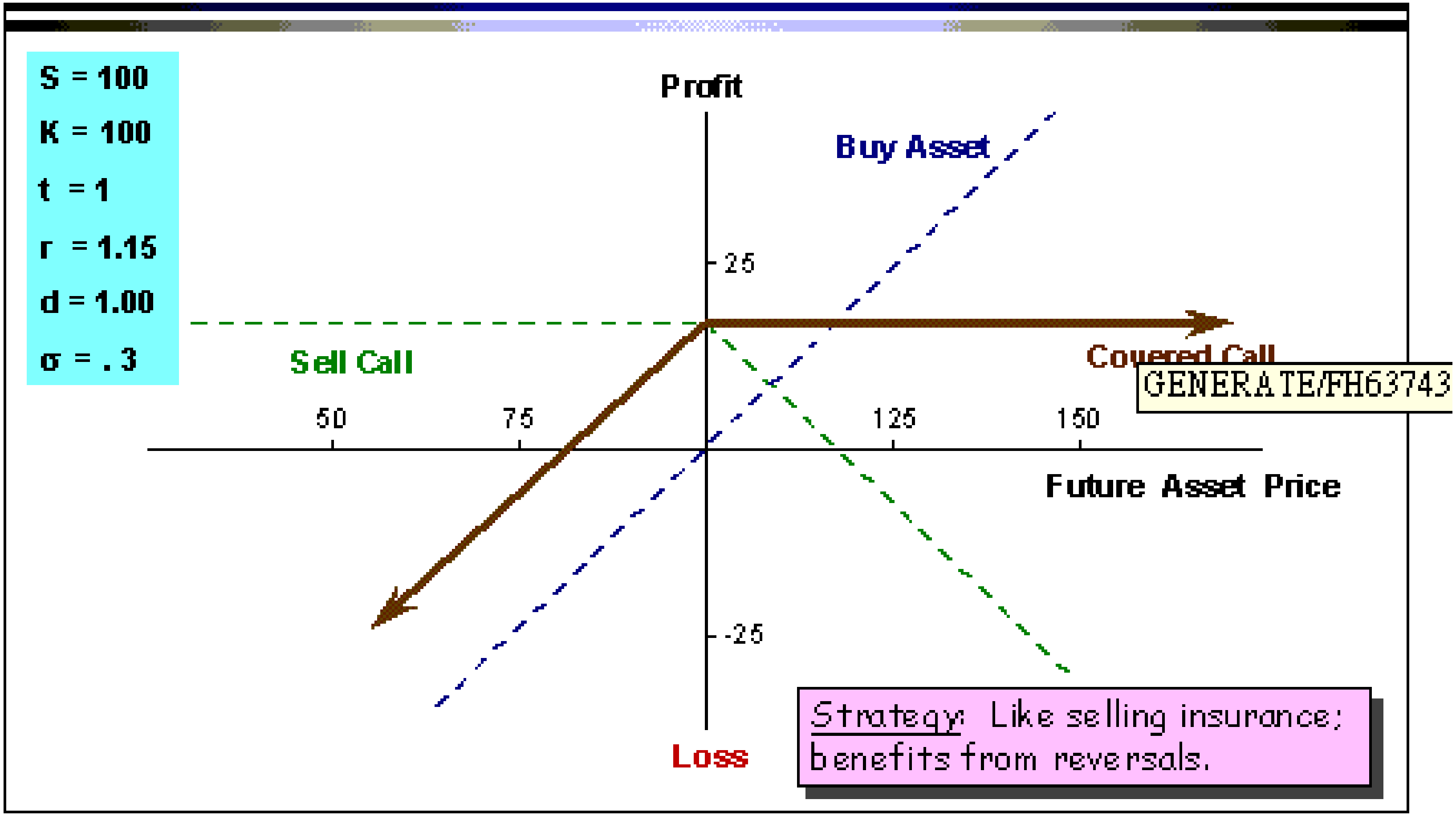
- Covered call: A long position in stock with a short call.

 (Example：買進股票同時賣出該股票的買權，在股價上漲時，買權之虧損可由股票的收益彌補)

Protective Put



Covered Call



Example：Protective Put

- 阿貴持有台指ETF(假設台股指數為5200點)，並同時買一張履約價5200賣權，權利金210點(契約乘數為一點50元)，透過此策略可保護指數低於履約價所造成的損失。
- 期初支付210點權利金：10500
- 最大可能損失:210點
- 損益兩平點:5410(5200+210)

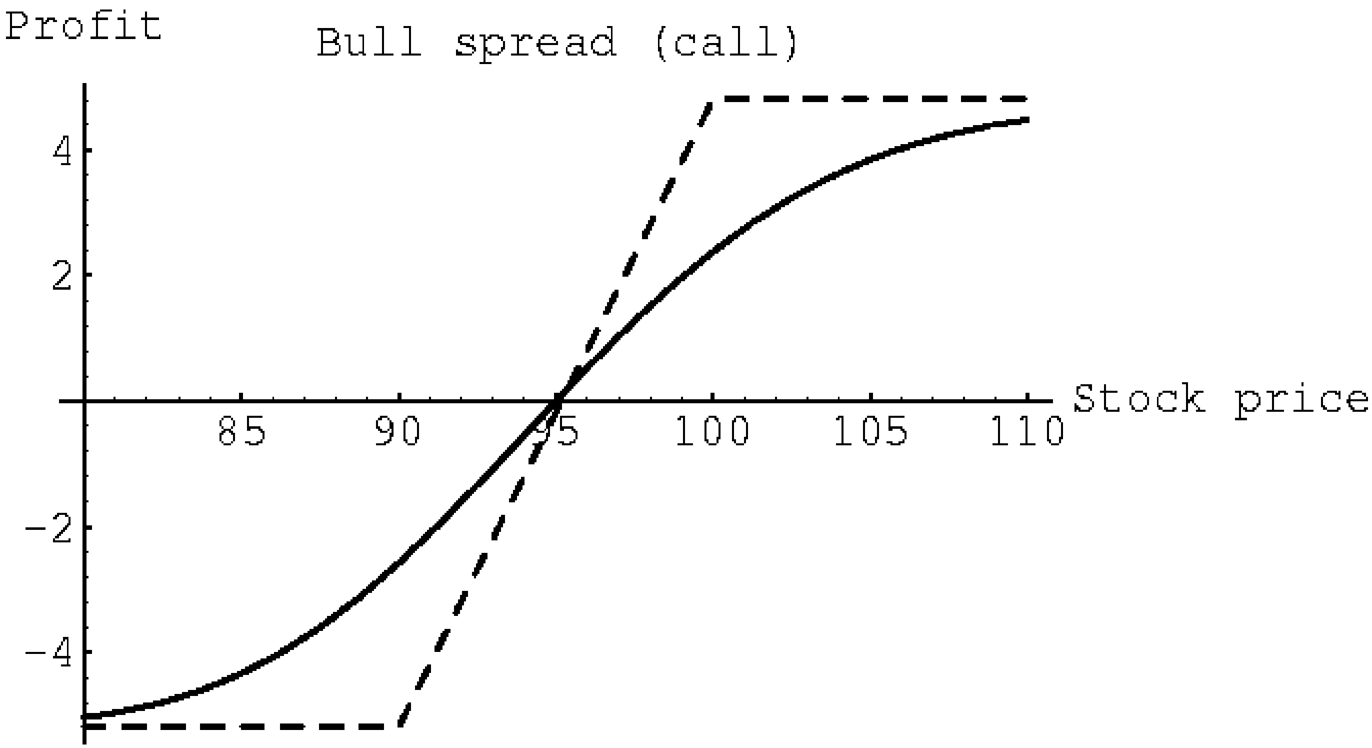
可動手畫出損益圖!

到期指數	ETF損益	賣權損益	權利金	淨損益(點)
5600	400	0	-210	190
5400	200	0	-210	-10
5200	0	0	-210	-210

Covered Position: Spread

- A spread consists of options of the same type and on the same underlying asset but with different strike prices or expiration dates.
- We use X_L, X_M, and X_H to denote the strike prices with $X_L < X_M < X_H$.
- Example： A bull call spread consists of ***a*** long X_L call and ***a*** short X_H call with the same expiration date.
  – The initial investment is $C_L - C_H$.
  – The maximum profit is $(X_H - X_L) - (C_L - C_H)$.
  – The maximum loss is $C_L - C_H$.

Bull Spread



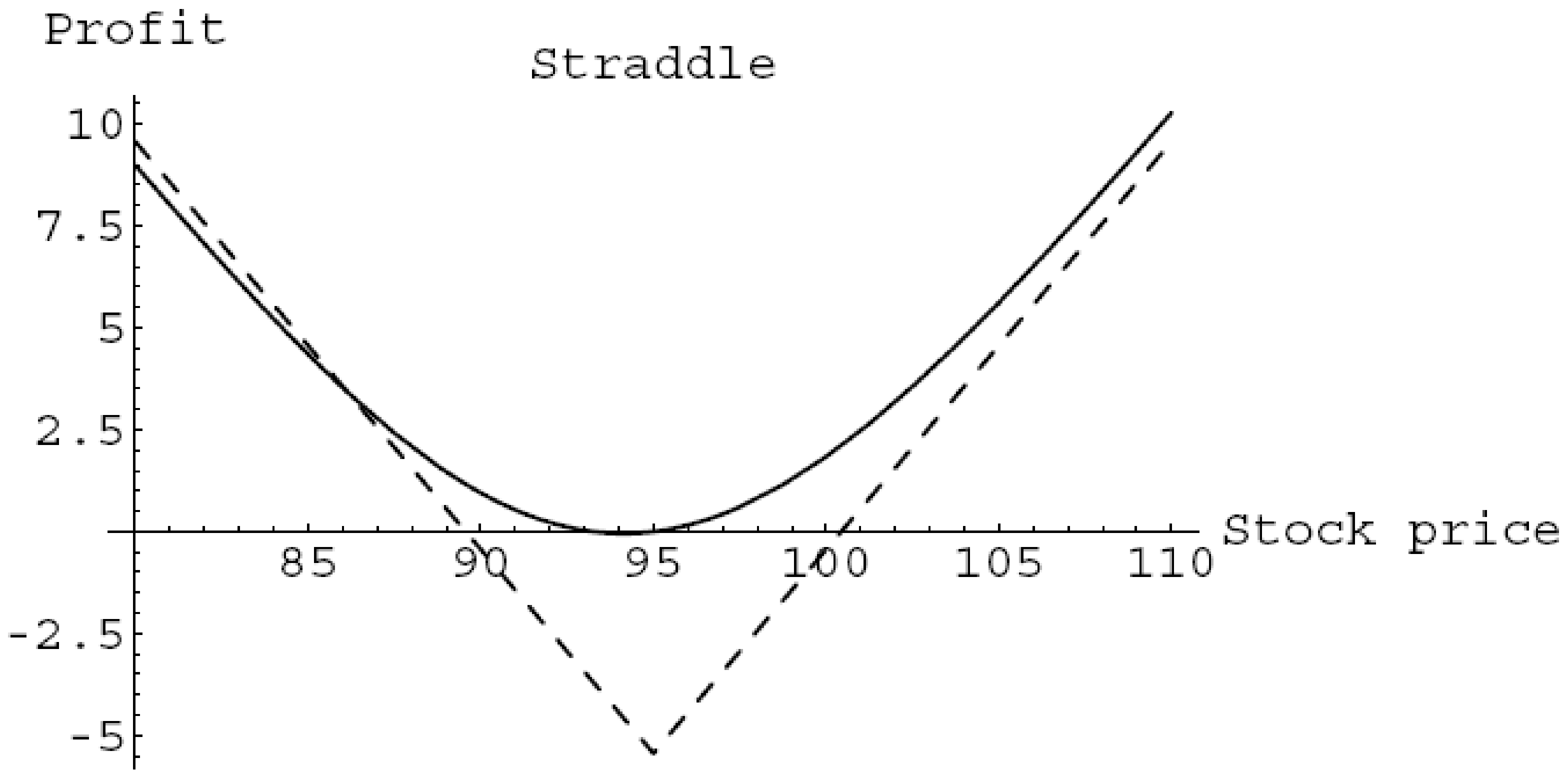
In Class Exercise
(Bear Spread)

- Construct a bear spread with two put options.
  - Long a put (strike price=X_H)
  - short a put (strike price=X_L)
- Draw the payoff chart for the bear spread
- Calculate the maximum profits/loss.

Covered Position: Combination

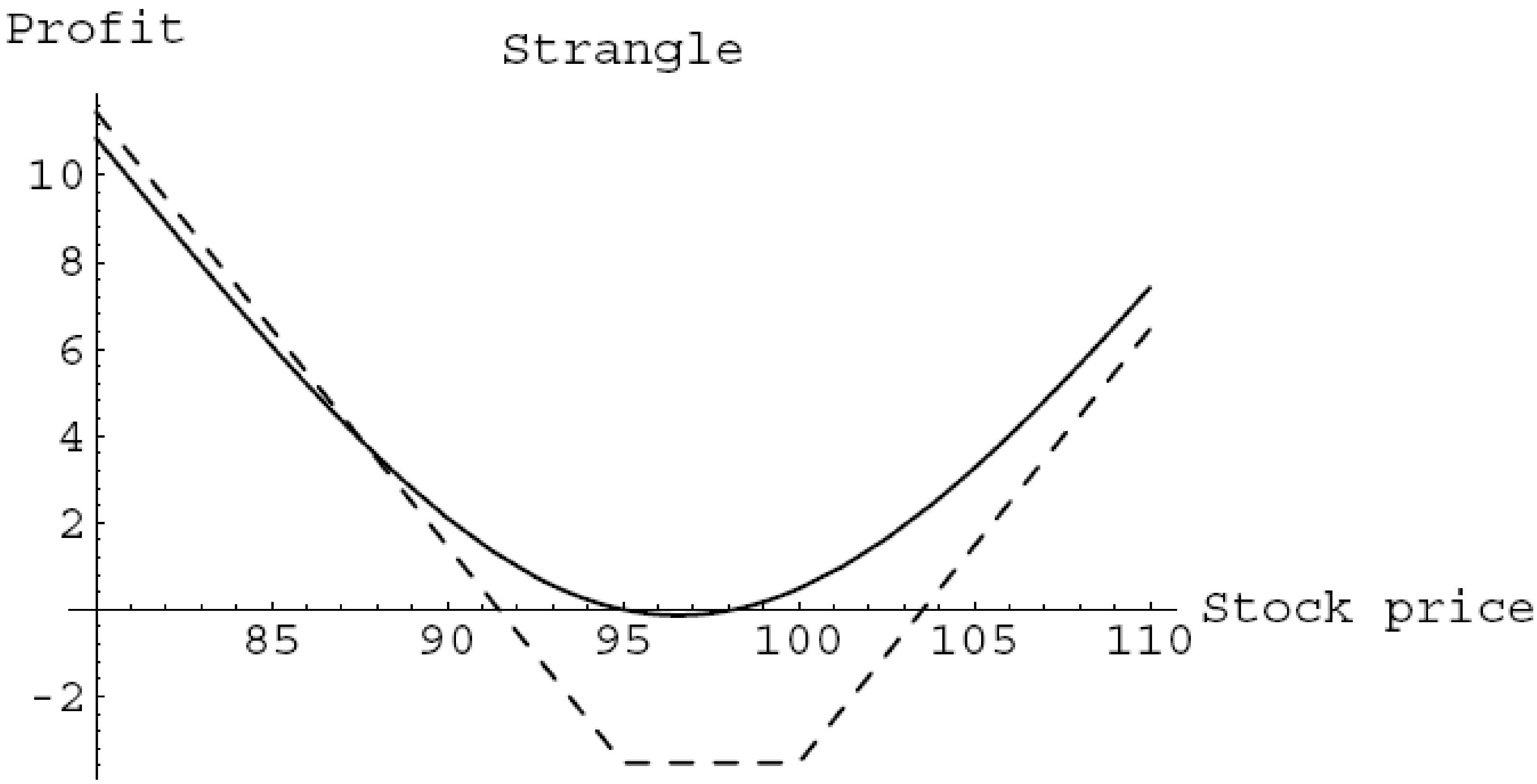
- A combination consists of options of different types on the same underlying asset, and they are either all bought or all written.
- Straddle: A long call and a long put with the same strike price and expiration date.
- Strangle: Identical to a straddle except that the call's strike price is higher than the put's.

Straddle



同時買進一口買權與賣權，履約價與到期日均相同。

Strangle



同時買進一口買權與賣權，到期日相同但買權的履約價比賣權高。

Example (Straddle)

- Say the Federal Reserve has indicated that it is strongly considering raising the Fed Funds rate to control inflation. A shape increase in interest rates may send stocks sharply lower, while a decrease in interest rate may boost XYZ to an all-time high.
- An investor expects that either of these outcomes could move the market up or down by 5% or more over a timeframe of approximately one month.

Example (Straddle)

- Index XYZ is currently at 100. The investor buys a one-month XYZ 100 call for $1.70, and a one-month XYZ 100 put for $1.50.
- The cost for the straddle is: $1.70 (call) + $1.50 (put) = $3.20.
- The total premium paid is therefore: $3.20 x 100 multiplier = $320.

Example (Straddle)

- By purchasing the straddle the investor is saying that by expiration he anticipates index XYZ to have either risen above the upside break-even point or below the downside break-even point:
- **Upside Break-Even Point:** 100＋$3.20 = 103.20
  Downside Break-Even Point: 100－$3.20 = 96.80

If you are interested in any strategies, you may access to the website http://www.cboe.com/Strategies