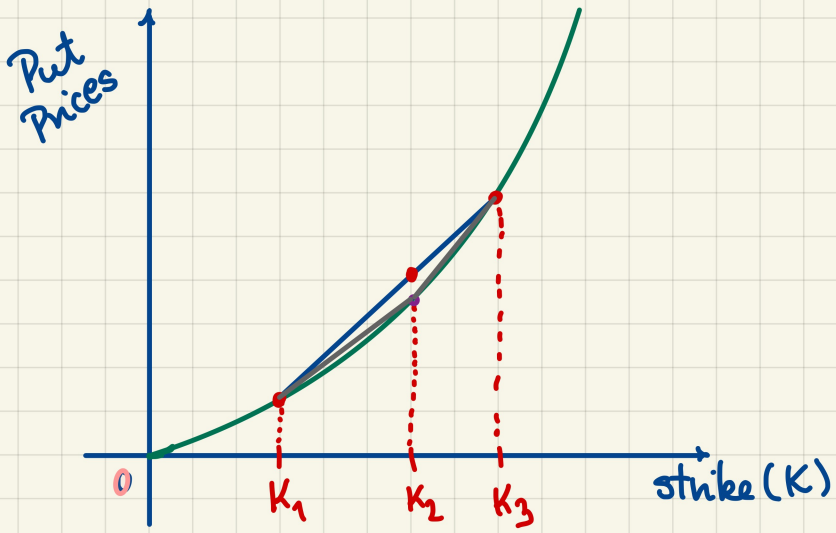
M339D: April 1st, 2022.

Put price Convexity.

$$V_p(T) = (\overset{0}{K} - S(T))_+ = 0$$



Claim. Let $\lambda = \dfrac{K_3 - K_2}{K_3 - K_1}$

Then,

$$V_p(K_2) \leq \lambda \cdot V_p(K_1) + (1-\lambda) V_p(K_3) \qquad (PC)$$

$$\Longleftrightarrow$$

$$\frac{V_p(K_2) - V_p(K_1)}{K_2 - K_1} \leq \frac{V_p(K_3) - V_p(K_2)}{K_3 - K_2}$$

Q: What would you do if there exist $K_1 < K_2 < K_3$ such that

$$V_p(K_2) > \lambda V_p(K_1) + (1-\lambda) V_p(K_3) \; ?$$

$\longrightarrow$:

✓ • Long	λ	K_1 · puts	Put
• short	1	K_2 · put	Butterfly
• Long	$1-\lambda$	K_3 · puts	Spread

Task: Put and call butterfly spreads have the same **payoff**. < graph. parity.

67.

Consider the following investment strategy involving put options on a stock with the same expiration date.

$K_1 = 25,\ K_2 = 30,\ K_3 = 35$

$K_2 = \frac{1}{2} K_1 + \frac{1}{2} \cdot K_3$

$K_2 = \frac{K_1 + K_3}{2}$

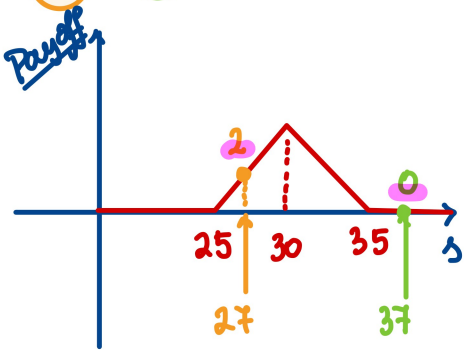
i) Buy one 25-strike put
ii) Sell two 30-strike puts
iii) Buy one 35-strike put

SYMMETRIC

Put Butterfly Spread

Calculate the payoffs of this strategy assuming stock prices (i.e., at the time the put options expire) of 27 and 37, respectively.

(A) –2 and 2
(B) 0 and 0
(C) 2 and 0
(D) 2 and 2
(E) 14 and 0



68.

For a non-dividend-paying stock index, the current price is 1100 and the 6-month forward price is 1150. Assume the price of the stock index in 6 months will be 1210.

Which of the following is true regarding forward positions in the stock index?

(A) Long position gains 50
(B) Long position gains 60
(C) Long position gains 110
(D) Short position gains 60
(E) Short position gains 110

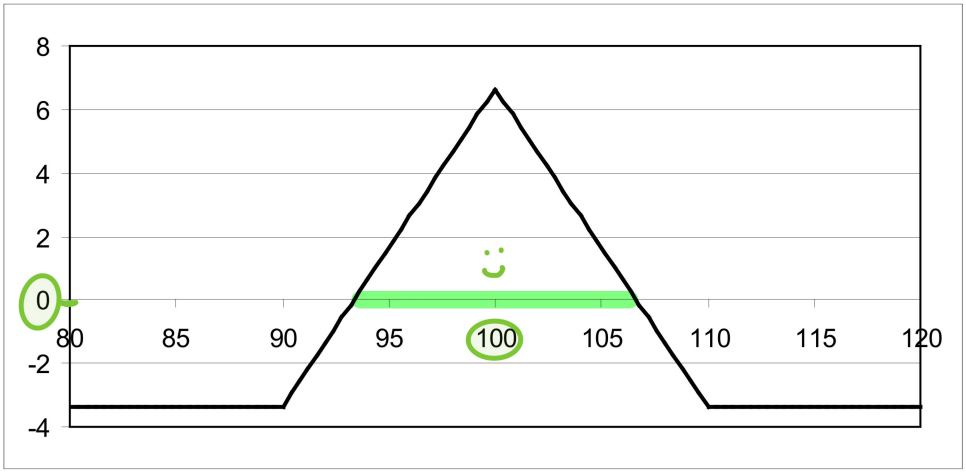
9.

Stock ABC has the following characteristics:

- The current price to buy one share is 100
- The stock does not pay dividends.
- European options on one share expiring in one year have the following prices:

Strike Price	Call option price	Put option price
90	14.63	0.24
100	6.80	1.93
110	2.17	6.81

A butterfly spread on this stock has the following profit diagram.



The continuously compounded risk-free interest rate is 5%.

Determine which of the following will NOT produce this profit diagram.

(A) Buy a 90 put, buy a 110 put, sell two 100 puts

(B) Buy a 90 call, buy a 110 call, sell two 100 calls

(C) Buy a 90 put, sell a 100 put, sell a 100 call, buy a 110 call

(D) Buy one share of the stock, buy a 90 call, buy a 110 put, sell two 100 puts

(E) Buy one share of the stock, buy a 90 put, buy a 110 call, sell two 100 calls.

Floor "looks like" a long call

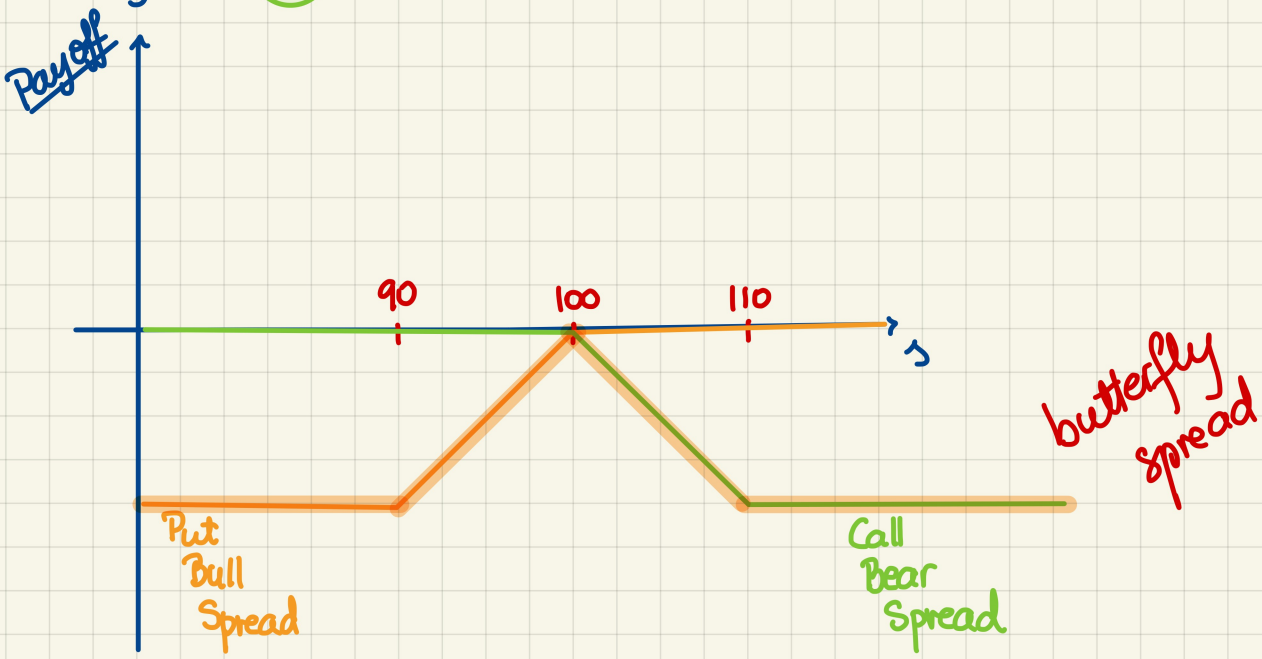
(c)
- buy a 90 put
- sell a 100 put

} Put Bull Spread

- sell a 100 call
- buy a 110 call

} Call Bear Spread

} Butterfly Spread



(d) slope of the payoff curve:

Long stock:	+1	+1	+1	+1
Long 90-call:	0	+1	+1	+1
2 short 100-puts:	+2	+2	0	0
Long 110-put:	-1	-1	-1	0
Total Portfolio:	+2			
	≠			
	0			

=> Does not replicate a butterfly spread!

(e) Do (e) "algebraically"; use put-call parity!

□