

Section 9 problems: (draft)

1. A non-dividend paying stock currently sells for 50. The risk free interest rate is 3% compounded continuously. A 2-year 50-strike put is selling for 4.40. A 2-year 50-strike call is trading at 7.31. A 2-year 50-strike floor position is purchased. Determine the break-even point.
2. A non-dividend paying stock currently sells for 50. The risk free interest rate is 3% compounded continuously. A 2-year 50-strike put is selling for 4.40. A 2-year 50-strike call is trading at 7.31. A 2-year 50-strike cap is written. Determine the break-even point.
3. A non-dividend paying stock currently sells for 50. The risk free interest rate is 3% compounded continuously. A 2-year 55-strike put is purchased for 6.40. Determine the no-arbitrage price of a 2-year 55-strike call.
4. A stock currently sells for 50. A dividend of 1 is paid at the end of each year. A dividend was just paid. The risk free interest rate is 3% compounded continuously. A 2-year 50-strike put is purchased for 4.80. Determine the price of a 2-year 50-strike call.
5. A stock currently sells for 50. Dividends are paid continuously at the constant rate of $\delta = 0.02$. The risk free interest rate is 3% compounded continuously. A 2-year 50-strike call is purchased for 5.75. Determine the price of a 2-year 50-strike put.
6. You are given:
 - i. The premium for a 3-month 50-strike put is 1.00
 - ii. The premium for a 3-month 50-strike call is 4.80
 - iii. The premium for a 3-month 60-strike put is 6.70
 - iv. The premium for a 3-month 60-strike call is 0.59
 - v. The risk free interest rate is 4% compounded quarterly.Determine the break-even point for a 3-month 50-60 bull spread.
7. You are given:
 - i. The premium for a 3-month 50-strike put is 1.00
 - ii. The premium for a 3-month 50-strike call is 4.80
 - iii. The premium for a 3-month 60-strike put is 6.70
 - iv. The premium for a 3-month 60-strike call is 0.59
 - v. The risk free interest rate is 4% compounded quarterly.Determine the break-even point for a 3-month 50-60 bear spread.

8. You are given:

- i. The premium for a 3-month 50-strike put is 1.00
- ii. The premium for a 3-month 50-strike call is 4.80
- iii. The premium for a 3-month 60-strike put is 6.70
- iv. The premium for a 3-month 60-strike call is 0.59
- v. The risk free interest rate is 4% compounded quarterly.

Determine the break-even point for a 3-month 50-60 written collar.

9. You are given:

- i. The premium for a 3-month 50-strike put is 1.00
- ii. The premium for a 3-month 50-strike call is 4.80
- iii. The premium for a 3-month 60-strike put is 6.70
- iv. The premium for a 3-month 60-strike call is 0.59
- v. The risk free interest rate is 4% compounded quarterly.

Determine the break-even points for a 50-60 3-month strangle

10. You are given:

- (i) the annual yield rate on a zero-coupon bond with duration of 1 year is 3%.
- (ii) the annual yield rate on a zero-coupon bond with duration of 2 years is 5%.
- (iii) the annual yield rate on a zero-coupon bond with duration of 3 years is 6%.

You would like to swap payments of 100, 200, and 300, due at the end of years 1, 2, and 3, respectively, for a level set of payments. Determine the swap price.

11. You are given:

- (i) the annual yield rate on a zero-coupon bond with duration of 1 year is 3%.
- (ii) the annual yield rate on a zero-coupon bond with duration of 2 years is 4%.
- (iii) the annual yield rate on a zero-coupon bond with duration of 3 years is 6%.

Determine the swap rate for a 1-year deferred 2-year interest rate swap.

12. Suppose that firms face a 40% income tax rate on all profits. In particular, losses receive full credit. Firm A has a 50% probability of a \$1000 profit and a 50% probability of a \$600 loss each year. Determine the expected pre-tax profit next year for Firm A. Determine the expected after-tax profit next year for Firm A.

13. Suppose that firms face a 40% income tax rate on positive profits while losses are not tax deductible. Firm A has a 50% probability of a \$1000 profit and a 50% probability of a \$600 loss each year. Determine the expected pre-tax profit next year for Firm A. Determine the expected after-tax profit next year for Firm A.

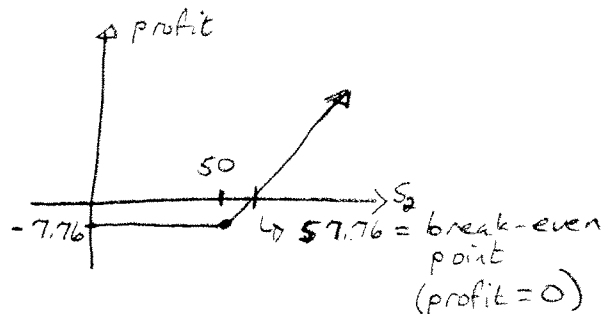
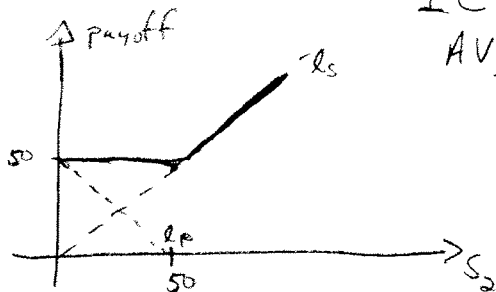
Section 9 Solutions

1) long floor (50) : long stock + long put (50)

$$IC = 50 + 4.40 = 54.40$$

$$AV_{IC} = 54.40 e^{.06} = 57.76$$

$$\text{profit} = \text{payoff} - 57.76 \quad (\text{shift payoff down } 57.76)$$

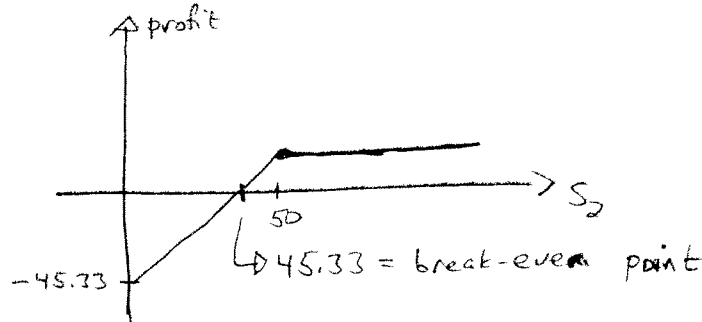
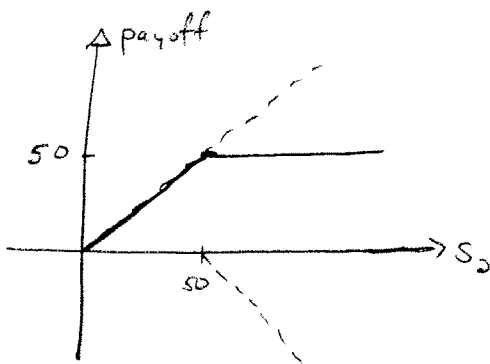


2) short cap (50) : long stock + short call (50)

$$IC = 50 - 7.31 = 42.69$$

$$AV_{IC} = 42.69 e^{.06} = 45.33$$

$$\text{profit} = \text{payoff} - 45.33$$



3) $\text{Call}(K,T) - \text{Put}(K,T) = F_{0,T}^P - K e^{-rT}$ (Put-Call Parity)

$$F_{0,T}^P = S_0 = 50 \quad \text{since no dividends}$$

$$\therefore \text{Call}(55,2) = 6.40 + 50 - 55 e^{-.06} = 4.60$$

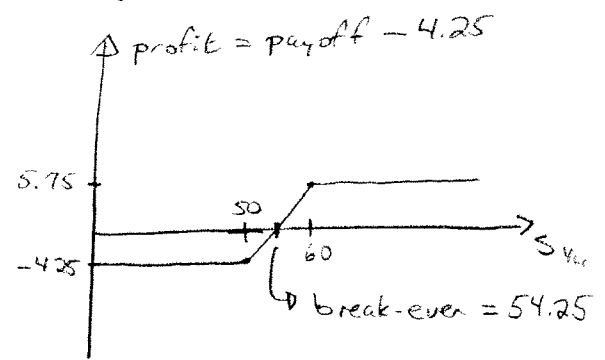
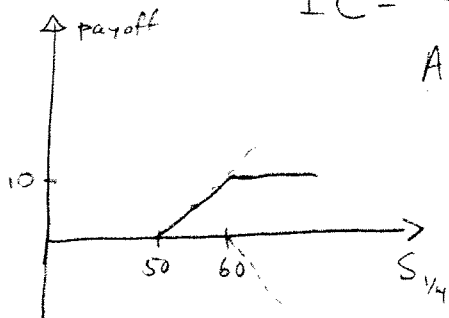
4) $Call(K,T) - Put(K,T) = F_{0,T}^P - K e^{-rT}$
 $F_{0,T}^P = S_0 - PV(\text{dividends}) = 50 - e^{-0.03} - e^{-0.06} = 48.09$
 $\therefore Call(50,2) = 4.80 + 48.09 - 50 e^{-0.06} \approx 5.80$

5) $F_{0,2}^P = S_0 e^{-2r} = 50 e^{-0.04} = 48.04$
 $\therefore Put(50,2) = 5.75 - 48.04 + 50 e^{-0.06} \approx 4.80$

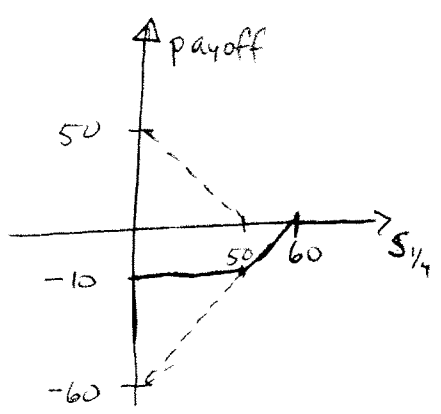
6) ⁵⁰⁻⁶⁰ bull spread : long call (50) + short call (60)

IC = 4.80 - 0.59 = 4.21

AV_{IC} = 4.21 (1.01) = 4.25



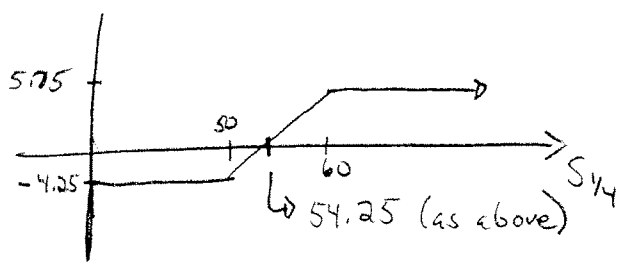
Remark: A 50-60 bull spread can also be achieved by:
 long put (50) + short put (60)



IC = 1 - 6.70 = -5.70

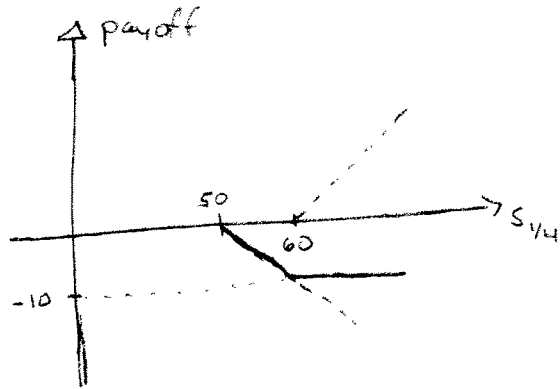
AV_{IC} = -5.76 (round-off error)
 use -5.75 to match above work.

profit = payoff + 5.75 = payoff + 5.75
 ↳ shift up



7) 50-60 bear spread (reverse the bull spread)

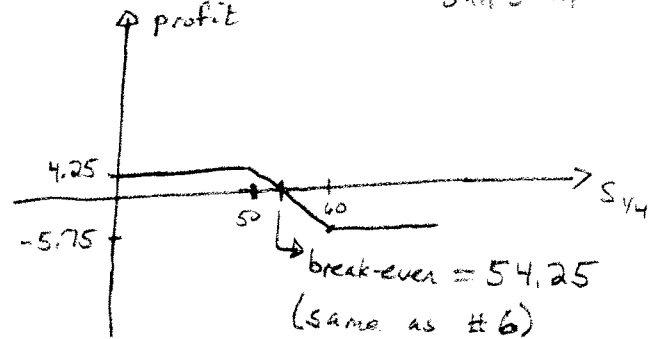
short call (50) + long call (60)



$$IC = -4.80 + 0.59 = -4.21$$

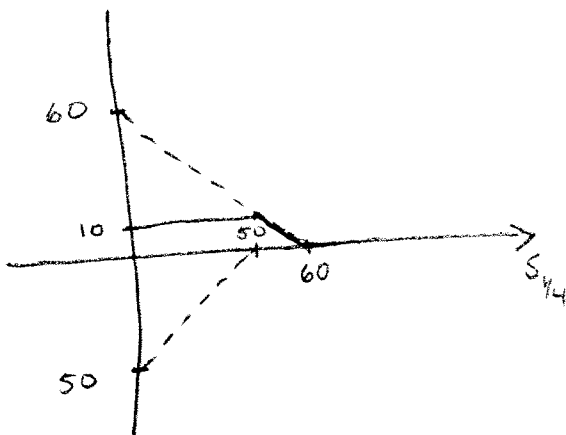
$$AV_{IC} = -4.21(1.01) = -4.25$$

$$\text{profit} = \text{payoff} + (+4.25) \text{ shift UP}$$



Remark: We can also reverse the position in the remark in #6, obtaining

short put (50) + long put (60)

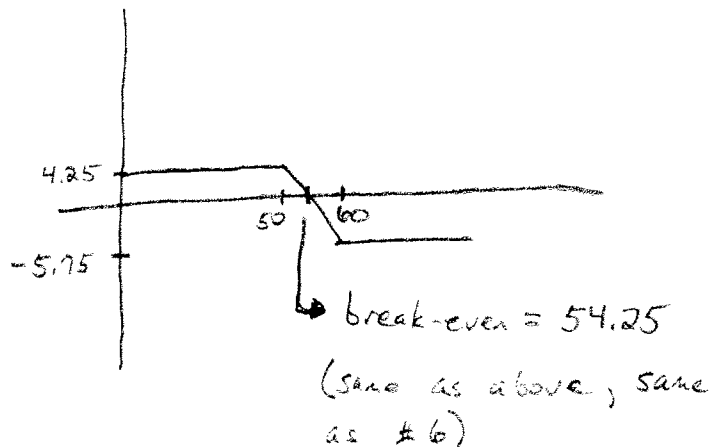


$$IC = -1.00 + 6.70 = 5.70$$

$$AV_{IC} \doteq 5.76 \text{ (round-off error)}$$

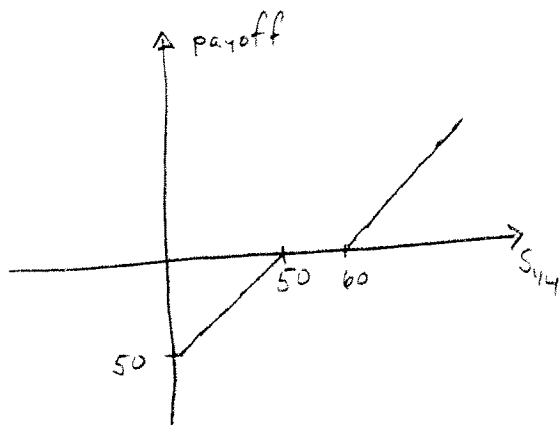
Use 5.75 to match above work.

$$\text{profit} = \text{payoff} - 5.75$$



Note: Bull and Bear Spreads are reverse positions, and so have the same break-even values.

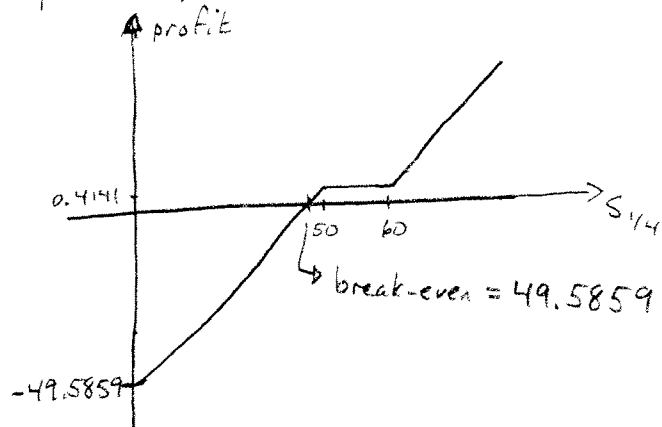
8) ⁵⁰⁻⁶⁰ written collar : short put (50) + long call (60)



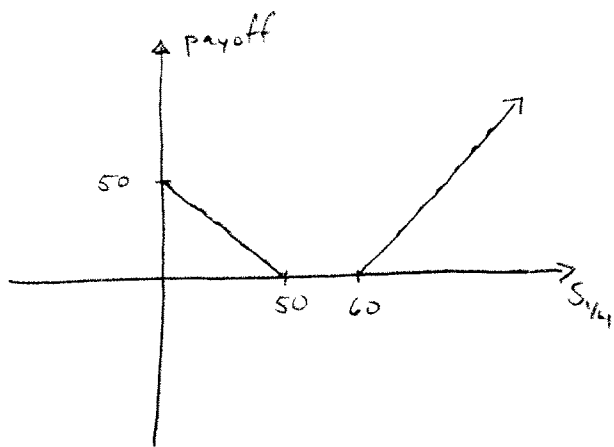
$$IC = -1.00 + 0.59 = -0.41$$

$$AV_{IC} = -0.41(1.01) = -0.4141$$

$$\text{profit} = \text{payoff} + (+0.4141)$$



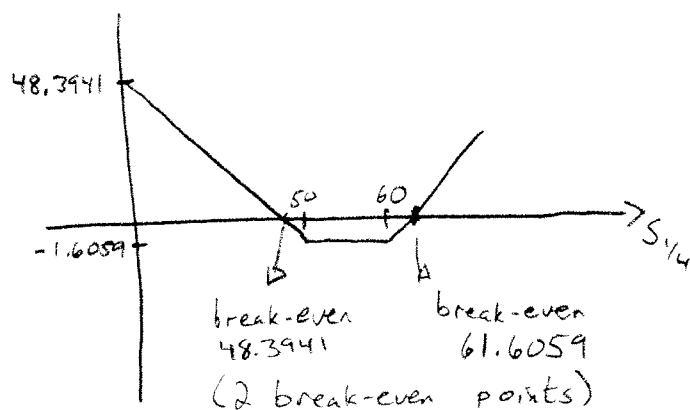
9) ⁵⁰⁻⁶⁰ purchased strangle : long put (50) + long call (60)



$$IC = 1.00 + 0.59 = 1.59$$

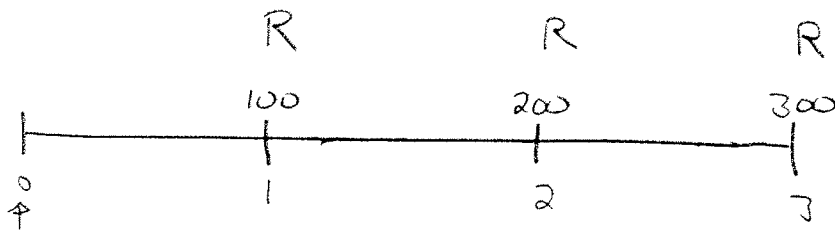
$$AV_{IC} = 1.59(1.01) = 1.6059$$

$$\text{profit} = \text{payoff} - 1.6059$$



Remark: A written strangle is the reverse position, and has the same break-even points.

10)



$$S_1 = .03$$

$$S_2 = .05$$

$$S_3 = .06$$

$$\therefore R v_{.03} + R v_{.05}^2 + R v_{.06}^3 = 100 v_{.03} + 200 v_{.05}^2 + 300 v_{.06}^3$$

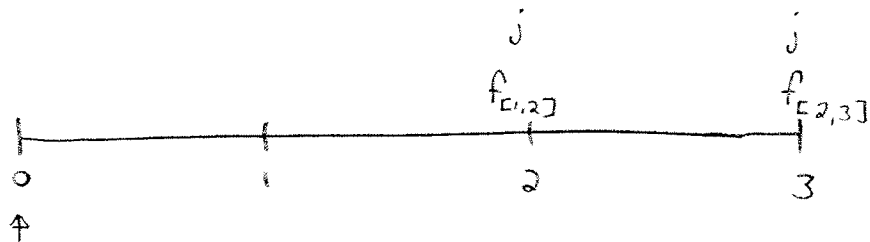
$$\Rightarrow R = 195.17 = \text{swap price}$$

11)

$$S_1 = .03$$

$$S_2 = .04$$

$$S_3 = .06$$



$$f_{[1,2]} \cdot v_{.04}^2 + f_{[2,3]} \cdot v_{.06}^3 = j v_{.04}^2 + j v_{.06}^3$$

$$\therefore j = \frac{\frac{(\frac{1.04^2}{1.03} - 1)}{(1.04)^2} + \frac{(\frac{1.06^3}{1.04^2} - 1)}{(1.06)^3}}{\frac{1}{1.04^2} + \frac{1}{1.06^3}} = 0.0744 = \text{swap rate}$$

	(50%) Profit = 1000	(50%) Profit = -600
(i): Pre-Tax	1000	-600
(ii): Taxable	1000	-600 (since losses receive full credit)
(iii) = (0.4) * (ii): Tax (40%)	400	-240
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(i) - (iii): After Tax Profit	600	-360

Expected After Tax Profit

$$= .5(600) + .5(-360) = 120$$

	(50%) Profit = 1000	(50%) Profit = -600
(i): Pre-Tax	1000	-600
(ii): Taxable	1000	0 (since losses are not tax deductible)
(iii) = 0.4(ii): Tax	400	0
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(i) - (iii): After Tax Profit	600	-600

Expected After Tax Profit

$$= .5(600) + .5(-600) = 0$$