1. $S_0 = \$175$

Sell 100 call (1 contract)

Sell 100 put (1 contract)

$K = \$175$

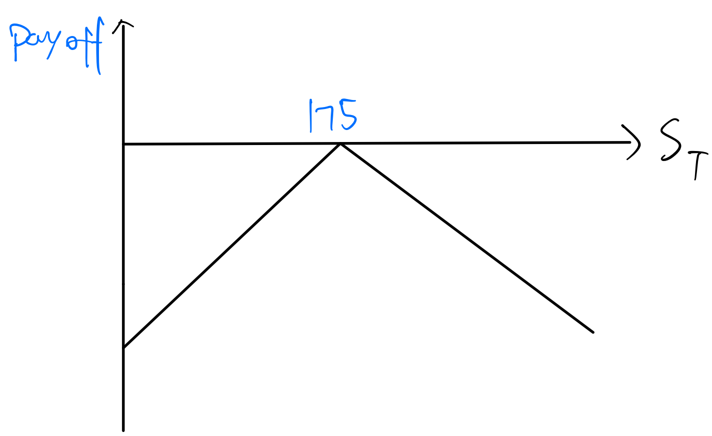
$T =$ Sept. 16 (4 weeks)

\$5/call, \$4.5/put

a) Pay off function

$$\text{Call} = \begin{cases} -100(175 - S_T) & S_T > 175 \\ 0 & S_T \leq 175 \end{cases}$$

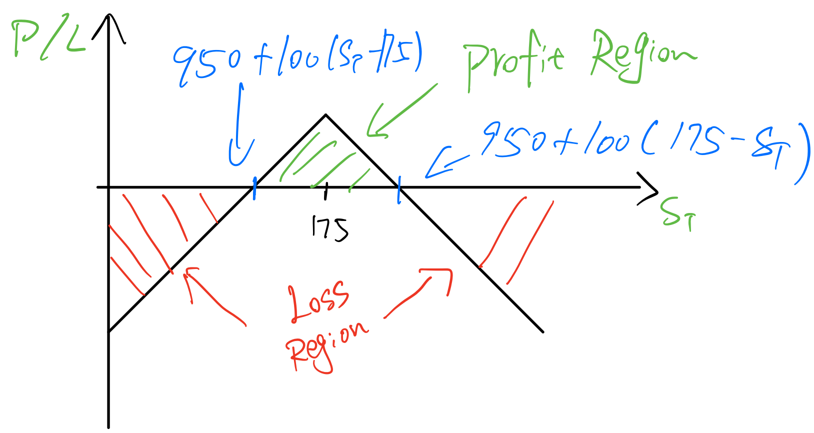
$$\text{Put} = \begin{cases} -100(S_T - 175) & S_T < 175 \\ 0 & S_T \geq 175 \end{cases}$$



b) P/L

Short Call P/L: $5×100 − 100(175 − S_T)

Short Put P/L: $4.5×100 − 100($S_T$ − 175)



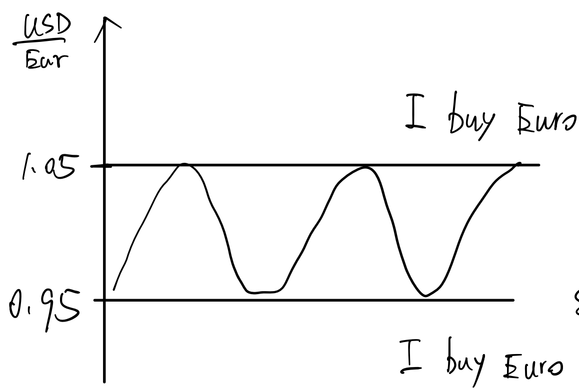
c) Max profit: $5×100 + $4.5×100 = $9500

Max loss: infinity

d). when $S_T \in (165.5, 184.5)$

e). Iron Condor type strategy is best for shorting volatility aka there is little price movement.

2. The Treasuer can buy Call with Strike price @0.95 with maturity Date 6 month from today.
Sell put with strike price 1.05 w/maturity Date 6 month from Today



← buy Call: Right to buy 1.05 USD/Euro

sell put: give counterparty the Right to sell 0.95 USD Per Euro

3. expect to buy 800000 spot Jet fuel in 3 month

a) $\sigma_F = (1-15\%)\sigma_S$ $\quad h^* = \rho\frac{\sigma_S}{\sigma_F}$ $\quad \rho = 0.8$

$$1 = 0.85\frac{\sigma_S}{\sigma_F}$$

$$\frac{1}{0.85} = \frac{\sigma_S}{\sigma_F} \Rightarrow h^* = 0.8 \cdot \frac{1}{0.85} = 0.9412$$

b). AAL should long in heating oil futures

$$N^* = \frac{h^* N_A}{Q_F}$$

$Q_F = 42000$ gallons / Contract

$N_A = 800000$

$$= \frac{0.9412 \times 800000}{42000}$$

$= 17.93 \approx 18$ Contracts $\Leftarrow$ optimal # of Contracts to take

c) Profit from hedging $= (\$4 - \$3.48) \times 42000 \times 18 = \$393120$

D) ① Buy $\$3.5 \times 800000 = \$2800000$

Profit from hedging $= (\$4 - \$3.48) \times 42000 \times 18 = \$393120$

Net Pay $=$ ① $-$ ② $= \$2800000 - \$393120 = \$2406880$

Yes, AAL is better off with the hedge B/c it generates profit.

4.

Bond principal ($)	Time to maturity (months)	Annual coupon ($)	Bond price ($)
100	6	0.0	98.49
100	12	0.0	96.87
100	18	3.0	99.64
100	24	3.0	99.38

a) Zero Coupon Rate 6m, 12m, 18m, 24m.

$A \cdot e^{-r \cdot n}$

6 month: $100 \cdot e^{-r_0(0.5) \cdot 0.5} = 98.49$

$r_0(0.5) = \ln\left(\frac{100}{98.49}\right) \cdot \frac{1}{0.5}$

$= 0.03043$

$= 3.043\%$

12 month: $100 \cdot e^{-r_0(1) \cdot 1} = 96.87$

$r_0(1) = \ln\left(\frac{100}{96.87}\right) \cdot 1$

$= 0.03180$

$= 3.180\%$

18 month: $1.5\, e^{-r_0(0.5) \cdot 0.5} + 1.5\, e^{-r_0(1) \cdot 1} + 101.5\, e^{-r_0(1.5)\, 1.5} = 99.64$

$\cdots\ r_0(1.5) = 0.032231$

$= 3.223\%$

24 month: $1.5\, e^{-r_0(0.5) \cdot 0.5} + 1.5\, e^{-r_0(1) \cdot 1} + 1.5\, e^{-r_0(1.5)\, 1.5} + 101.5\, e^{-r_0(2) \cdot 2} = 99.38$

$\cdots\ r_0(2) = 0.032984$

$= 3.298\%$

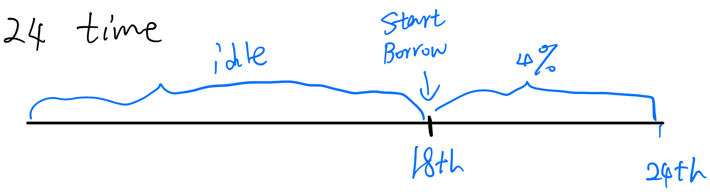
B). Borrow and lend \$100 @ zero spot Rate

Given the condition in Question, There is arbitrage Room

The max Profit is calculated below by

borrowing money @ zero Rate given at 18th month in

24 time



$$100\left(e^{0.04\times0.5} - e^{0.03042\times0.5}\right) = 0.488$$

5. $T = 12$ Month $5\% / yr$ $S_0 = \$50$

a) Forward Price $F_0(T) = S_0 e^{rT}$

$$= 50 \cdot e^{0.05 \cdot 1}$$

$$= \$52.56$$

b) $F_0(T) = 55 > S_0 e^{rT} = 52.56$

$t = 0$ borrow 50 / share @ 5%

buy 1 unit Asset of Short position in forward

$t = 12$ sell the asset @ \$55

gain : $55 - 52.56 = 2.44$

c) $F_0(T) = 45 < S_0 e^{rT} = 52.56$

$t = 0$ sell 1 unit of asset @\$52.56

$t = 12$ buy 1 unit of asset @\$45

gain : $52.56 - 45 = \$7.56$