Midterm Exam Soln
Finance Options Markets, Liwen Wu

a) Long a forward contract, payoff is $(S_T - K) = (S - 55)$
   If $S_T = 50$, payoff = $50 - 55 = -5$
   If $S_T = 60$, payoff = $60 - 55 = 5$

b) $S_T$ is the payoff
   $K$

Cc) $S_e = 50$. $F = S_e e^{r(T-t)} = 50 e^{0.05x1} = 52.56$

(d) Value = $e^{-r(T-t)} (F - K) = e^{-0.05x1} (52.56 - 55) = -2.32$

(e) If $F = 50$, lower than the "buy & carry" value of 52.56, we would
   long forward, set short replication.

Today: Long forward, short sell the security, receive 50.
   Save the money in bank.

Expiry: Execute the forward, buy 1 share of security, pay 50.
   Use the security to cover short sell.
   The money from bank becomes $50 e^{0.05x1} = 52.56$,
   more than enough to cover the payment.
2. (a) Payoff of short call is $-(S_T - K)^+ = -(S_T - 100)^+$

$S_T = 90,
\text{ Payoff} = -(90 - 100)^+ = 0$

$S_T = 110,
\text{ Payoff} = -(110 - 100)^+ = -10$

(b) 

3. Payoff of long call at $120$ & short put at $80$ is

$= (S_T - 120)^+ - (80 - S_T)^+$

If $S_T < 80$, Payoff $= 0 - (80 - S_T) = S_T - 80$

If $S_T \in (80, 120)$, Payoff $= 0 - 0 = 0$

If $S_T > 120$, Payoff $= S_T - 120 - 0 = S_T - 120$

(a) $S_T = 70,
\text{ Payoff} = S_T - 80 = -10$

$S_T = 110,
\text{ Payoff} = 0$

(b) 

\[ \text{Payoff} \]
4. \( F = 120, \ C = 4, \ p = 3, \ K = 120 \)

Put-call parity: \( C - P = e^{-rT} (F - K) \)

\( F - K = 0 \), \( C - P = 1 \).

Hence, \( C - P \) is too expensive relative to \( F \).

Strategy: Sell \( C - P \) → long sell a call at 120, buy a put at 120

Long forward at 120.

Today:
 sell call +4
 buy put -3
 long forward 0

\( \therefore \ 4 \).

Expiration: The payoffs from \( C - P \) is the same as the forward payoff. Hence, nothing is left.

5. \( K = 100, \ C = 5 \), \( F = 90 \).

(a) \( F \geq K \) in the money.

\( F \geq K \), out of the money.

(b) Intrinsic value = \( e^{-rT} (F - K)^+ = 0 \).

Time value = \( C - \text{intrinsic value} = 5 - 0 = 5 \).
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6.

(a) 100 ≤ \( S_3 \) (110-85) = 27

\( P_3 = 0 \) (110-85) = 27

Replication: \( 0 = \Delta \cdot 120 + D \)
\[ 27 = \Delta \cdot 83 + D \]

\[ \Delta = \frac{0-27}{120-83} = -0.7297 \]

\[ D = -\Delta \cdot 120 = 0.7297 \times 120 = 87.57 \]

\[ \text{Value of the call} = -0.7297 \times 100 + 87.57 - 0.05 \times 1 \]

\[ = 10.33 \]

(b) If put = 412, more expensive than replication.

Sell put, buy replication.

Today: Sell put \( (\text{E120} + 12 \)

Buy replication: short 83 stock + 0.7297 \times 110
Buy bond - 87.57 \( e^{0.05 \times 1} \)

\[ 12 - 10.33 = 1.67 \]

Equity: Payoff is perfectly matched, nothing is left.