CMSC 5718 Introduction to Computational Finance

Optional Assignment – answers

1. Performance evaluation

Sharpe ratio of Portfolio A = (5.5% – 2%) / 15% = 0.233
Treynor ratio of Portfolio A = (5.5% – 2%) / 0.60 = 0.0583
Sharpe ratio of S&P 500 = (7% – 2%) / 11% = 0.455
Treynor ratio of S&P 500 = (7% – 2%) / 1 = 0.05
According to the Sharpe ratio, Portfolio A underperforms the S&P 500 index, whereas if the Treynor ratio is compared, Portfolio A is better than the S&P 500 index.

2. Equity Portfolio Management

(i) Expected return = $R_f + \beta \times (R_m - R_f)$ = 0.04 + 0.7 x (0.085 – 0.04) = 7.15% p.a.
(ii) EPS next year = 6 x (1+0.06) = $6.36. Share price = EPS x P/E = 6.36 x 8.4 = $53.424
(iii) Total cash received after 1 year = 53.424 + 2.40 = $55.824
Total return = 55.824/50.00 –1 = 11.648% p.a., which is higher than that indicated by CAPM.
Therefore he should recommend the stock as a "buy".
Alternatively, fair price now = 2.40 + 53.424/(1+0.0715) = $52.26 > $50, therefore recommend "buy".

3. Risk management

(i) Delta equivalent of the option position = N = 2500000 x 0.55 = $1,375,000
VAR under delta-normal method = N x 2.33 x σ x sqrt(t)
= 1375000 x 2.33 x 0.25 x sqrt(1/250) = $50,655.7
(ii) VAR figure calculated in (i) above means that there is a 99% that the daily loss would be less than $50,655.7. However, within 1 calendar year, there would probably be 2 or 3 days when the loss would be greater than the calculated VAR. So this one single incident may not indicate anything wrong with the calculation. It would be a case of concern if the VAR is breached frequently.

4. Derivative Strategies

(a) *Arbitrage Strategy*
By put-call parity, Call – Put = Stock – Strike x exp(–rt)
Left hand side = 9.24 – 6.77 = $2.47, Right hand side = 100 – 98.5 x 0.9852 = $2.9578
Since the left hand side is cheaper than the right hand side, we should buy the left and sell the right, i.e. we should:
1) buy a call option and pay $9.24;
2) sell a put option and receive $6.77;
3) sell stock to receive $100.
The net cash received is 100 – 9.24 +6.77 = $97.53.

4) Deposit this amount today for 0.75 year, to get 97.53 x 1.015 = $98.993.
At maturity, if stock price is above $98.5, we can exercise the call and buy the stock at $98.5, and return the stock. If stock price is below $98.5, the put will be exercised and we will receive stock and pay $98.5. So in both cases, the result is we pay $98.5 and receive stock, which can then be used to close out the transaction from step 3. The net profit is thus 98.993 – 98.5 = $0.493 at maturity.

Alternatively, step 4 above can be replaced by using the exact term as indicated by the put-call parity. Instead of depositing $97.53, we can deposit 98.5 x 0.9852 = $97.0422 for 0.75 year. After 0.75 year, this amount will generate 97.0422 x 1.015 = $98.5, which can then be used to settle the option transaction (same reasoning as above). The net profit is thus: 97.53 – 97.0422 = $0.4878 today.

(b) *Option strategies*

One possible strategy is as follows:

Long 1 call at strike 100
Short 1 call at strike 150
Long 1 put at strike 100
Short 1 put at strike 80
Short 2 puts at strike 50

Stock price at expiry	$S_T \leq 50$	$50 < S_T \leq 80$	$80 < S_T \leq 100$	$100 < S_T \leq 150$	$150 \leq S_T$
Payoff from $c(100)$	0	0	0	$S_T - 100$	$S_T - 100$
Payoff from $-c(150)$	0	0	0	0	$-(S_T - 150)$
Payoff from $p(100)$	$100 - S_T$	$100 - S_T$	$100 - S_T$	0	0
Payoff from $-p(80)$	$-(80 - S_T)$	$-(80 - S_T)$	0	0	0
Payoff from $-2p(50)$	$-2(50 - S_T)$	0	0	0	0
Total payoff	$2S_T - 80$	20	$100 - S_T$	$S_T - 100$	50

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