# Module 12.4

Dynamic Risk Measures

ABM-Based Option Valuation Model

1

## Overview

- Follows Module 12.3 closely
- Performance of 7 strategies, 3 variables simulated, and 3 different strike prices
- Focus, for illustration, on correlation effects
  - Stock returns and volatility
  - Stock returns and interest rates
  - Volatility and interest rates

 

2

## Central Finance Concepts

- Explore influence of normal distribution
- Explore performance of seven strategies
- Monte Carlo simulate three input variables
- Evaluate three strike prices
- Goal
  - Illustrate power of simulation
  - Potentially identify outcomes not seen in history

 

3

## Seven Strategies

1. Long stock
2. Long call
3. Long put
4. Covered call writing (1. – 2.)
5. Protective put buying (1. + 3.)
6. Leveraged calls (1. + 2.)
7. Leveraged puts (1. – 3.)

 

4

## Simulation of Three Variables

- Stock price
- Volatility
- Interest rate
- Explore correlation effects typically absent in option-based strategy analysis

 

5

## Three Strike Prices

- Low strike price (call ITM, put OTM)
- At-the-money strike price
- High strike price (call OTM, put ITM)
- Enables exploration of influence of implied leverage influence on performance
- Return VaR-focused based on correlation
- Higher confidence interval because higher number of simulations

 

6

## Inputs Assumed

- Stock price = $100
- Strike prices
  - XL = $90
  - X = $100
  - XH = $110
- Interest rate = 5%
- Dividend yield = 0%
- Volatility = $29.8848
- Maturity = 1 year
- Style
  - European Only
- Type = Vanilla

 

7

## Simulation Inputs Assumed

- Horizon = 1 month
- Confidence level = 95%
- Simulations = 10,000
- Means
  - Stock = 5%
  - Rate = 0%
  - Volatility = 0%
- Standard deviations
  - Stock = 30%
  - Rate = 10%
  - Volatility = 40%
- Correlations
  - Stock, Rate = –0.3
  - Rate, Volatility = 0.0
  - Stock, Volatility = –0.5

 

8

*Table 12.4.1 Return VaR Based on ABMOVM Stock Return and Volatility Correlation*

| Strategy\Correlation | -0.75 | -0.50 | -0.25 | 0.00 | 0.25 | 0.50 | 0.75 |
|---|---|---|---|---|---|---|---|
| LS | 3.66 | 3.66 | 3.64 | 3.58 | 3.58 | 3.62 | 3.61 |
| LCXL | 13.52 | 14.38 | 14.86 | 15.41 | 16.18 | 16.38 | 17.01 |
| LCX | 16.01 | 17.27 | 18.15 | 18.88 | 20.07 | 20.46 | 21.28 |
| LCXH | 18.73 | 20.57 | 21.98 | 23.14 | 24.64 | 25.18 | 26.35 |
| LPXL | 33.30 | 31.31 | 30.05 | 28.87 | 27.50 | 24.97 | 23.08 |
| LPX | 27.49 | 25.67 | 24.82 | 23.98 | 23.02 | 20.92 | 19.79 |
| LPXH | 22.34 | 20.93 | 20.28 | 19.64 | 19.05 | 17.48 | 16.89 |
| LCCWXL | 1.19 | 1.06 | 0.91 | 0.79 | 0.63 | 0.49 | 0.29 |
| LCCWX | 1.66 | 1.53 | 1.37 | 1.25 | 1.08 | 0.94 | 0.76 |
| LCCWXH | 2.13 | 2.01 | 1.86 | 1.74 | 1.59 | 1.46 | 1.30 |
| LPPBXL | 2.27 | 2.43 | 2.53 | 2.62 | 2.77 | 2.81 | 2.92 |
| LPPBX | 1.74 | 1.89 | 2.01 | 2.11 | 2.26 | 2.31 | 2.42 |
| LPPBXH | 1.20 | 1.34 | 1.46 | 1.55 | 1.68 | 1.72 | 1.82 |
| LLCXL | 5.31 | 5.46 | 5.50 | 5.51 | 5.68 | 5.74 | 5.88 |
| LLCX | 5.17 | 5.34 | 5.41 | 5.42 | 5.60 | 5.70 | 5.82 |
| LLCXH | 4.93 | 5.08 | 5.17 | 5.19 | 5.37 | 5.46 | 5.57 |
| LLPXL | 5.24 | 5.11 | 4.96 | 4.79 | 4.66 | 4.57 | 4.38 |
| LLPX | 6.01 | 5.88 | 5.70 | 5.50 | 5.37 | 5.27 | 5.05 |
| LLPXH | 6.97 | 6.83 | 6.67 | 6.46 | 6.31 | 6.23 | 6.01 |

Key Insights: 1) Return VaR is slow to converge as illustrated with LS (correlation should have no influence). 2) For LC, Return VaR increases with X and for LP, Return VaR decreases with X (implied leverage effect). 3) Option blend strategies have lower Return VaR. 4) Compared with LS, lower Return VaR for LCCW and LPPB due to deleveraging, whereas higher Return VaR for LLC and LLP due to leveraging. 5) Correlation between stock return and volatility has significant impact on Return VaR although theoretically no impact on model option values.

 

9

*Table 12.4.2 Return VaR Based on ABM BOVM Stock Return and Interest Rate Correlation*

| Strategy\Correlation | -0.75 | -0.50 | -0.25 | 0.00 | 0.25 | 0.50 | 0.75 |
|---|---|---|---|---|---|---|---|
| LS | 3.62 | 3.58 | 3.57 | 3.62 | 3.55 | 3.69 | 3.66 |
| LCXL | 13.98 | 13.99 | 14.09 | 14.29 | 13.98 | 14.53 | 14.37 |
| LCX | 16.80 | 16.89 | 17.00 | 17.08 | 16.88 | 17.48 | 17.25 |
| LCXH | 20.15 | 20.24 | 20.44 | 20.41 | 20.30 | 20.89 | 20.55 |
| LPXL | 31.81 | 32.12 | 31.41 | 32.05 | 31.97 | 31.54 | 32.12 |
| LPX | 26.24 | 26.49 | 26.01 | 26.40 | 26.41 | 25.98 | 26.56 |
| LPXH | 21.31 | 21.46 | 21.28 | 21.41 | 21.45 | 21.15 | 21.52 |
| LCCWXL | 1.12 | 1.02 | 1.03 | 1.04 | 1.00 | 1.02 | 1.02 |
| LCCWX | 1.59 | 1.48 | 1.47 | 1.51 | 1.45 | 1.49 | 1.49 |
| LCCWXH | 2.07 | 1.95 | 1.96 | 1.96 | 1.93 | 1.97 | 1.97 |
| LPPBXL | 2.37 | 2.37 | 2.37 | 2.39 | 2.32 | 2.42 | 2.37 |
| LPPBX | 1.87 | 1.86 | 1.86 | 1.86 | 1.82 | 1.89 | 1.84 |
| LPPBXH | 1.33 | 1.33 | 1.33 | 1.31 | 1.29 | 1.32 | 1.28 |
| LLCXL | 5.32 | 5.32 | 5.32 | 5.40 | 5.31 | 5.52 | 5.48 |
| LLCX | 5.21 | 5.21 | 5.21 | 5.28 | 5.19 | 5.39 | 5.33 |
| LLCXH | 4.97 | 4.98 | 4.97 | 5.04 | 4.95 | 5.14 | 5.09 |
| LLPXL | 5.13 | 4.96 | 5.00 | 5.03 | 5.02 | 5.13 | 5.09 |
| LLPX | 5.88 | 5.70 | 5.75 | 5.79 | 5.77 | 5.90 | 5.86 |
| LLPXH | 6.83 | 6.66 | 6.71 | 6.74 | 6.73 | 6.89 | 6.82 |

Key Insights: 1) Patterns observed from prior table remain the same. 2) Correlation between stock returns and interest rates do not have a material influence on option strategy performance.

 

10

*Table 12.4.3 Return VaR Based on ABM BOVM Volatility and Interest Rate Correlation*

| Strategy\Correlation | -0.75 | -0.50 | -0.25 | 0.00 | 0.25 | 0.50 | 0.75 |
|---|---|---|---|---|---|---|---|
| LS | 3.62 | 3.57 | 3.66 | 3.57 | 3.60 | 3.63 | 3.69 |
| LCXL | 14.10 | 13.98 | 14.27 | 14.05 | 14.28 | 14.33 | 14.30 |
| LCX | 16.91 | 16.87 | 17.10 | 16.86 | 17.17 | 17.15 | 17.21 |
| LCXH | 20.20 | 20.25 | 20.42 | 20.11 | 20.42 | 20.42 | 20.65 |
| LPXL | 31.57 | 31.83 | 31.59 | 31.59 | 32.13 | 31.77 | 31.28 |
| LPX | 26.05 | 26.29 | 26.01 | 26.00 | 26.46 | 26.10 | 25.85 |
| LPXH | 21.15 | 21.53 | 21.26 | 21.09 | 21.50 | 21.21 | 21.07 |
| LCCWXL | 1.02 | 1.02 | 1.06 | 1.03 | 1.05 | 1.05 | 1.09 |
| LCCWX | 1.47 | 1.47 | 1.52 | 1.49 | 1.51 | 1.50 | 1.55 |
| LCCWXH | 1.96 | 1.95 | 2.00 | 1.97 | 1.98 | 1.97 | 2.03 |
| LPPBXL | 2.38 | 2.35 | 2.41 | 2.36 | 2.40 | 2.41 | 2.41 |
| LPPBX | 1.87 | 1.86 | 1.89 | 1.85 | 1.88 | 1.88 | 1.88 |
| LPPBXH | 1.32 | 1.33 | 1.34 | 1.30 | 1.33 | 1.32 | 1.33 |
| LLCXL | 5.38 | 5.31 | 5.43 | 5.32 | 5.37 | 5.41 | 5.48 |
| LLCX | 5.26 | 5.19 | 5.30 | 5.20 | 5.25 | 5.29 | 5.35 |
| LLCXH | 5.02 | 4.97 | 5.06 | 4.97 | 5.02 | 5.06 | 5.10 |
| LLPXL | 5.04 | 4.99 | 5.13 | 5.03 | 5.06 | 5.06 | 5.15 |
| LLPX | 5.79 | 5.74 | 5.89 | 5.77 | 5.81 | 5.82 | 5.91 |
| LLPXH | 6.75 | 6.67 | 6.87 | 6.71 | 6.75 | 6.79 | 6.89 |

Key Insights: 1) Patterns observed from prior tables remain the same. 2) Correlation between volatility and interest rates do not have a material influence on option strategy performance.

 

11

## Quantitative Finance Materials

- Analysis presented here based on valuation models previously covered
  - Module 5.5 (Valuation)
  - Module 8.4 (Static Risk Measures)
- Large number of alternative strategies could be covered
  - Alternative option-based strategies
  - Portfolios of stocks rather than just one

 

12

## ABMOVM

$$c_t = \left(S_t e^{-\delta(T-t)} - Xe^{-r(T-t)}\right) N(d_n) + \sigma_A e^{-r(T-t)} n(d_n)$$

$$p_0 = \left(Xe^{-r(T-t)} - S_0 e^{-\delta(T-t)}\right) N(-d_n) + \sigma_A e^{-r(T-t)} n(d_n)$$

$$n(d) = \frac{e^{-d^2/2}}{\sqrt{2\pi}}, \text{ (standard normal probability density function)}$$

$$A = \frac{B_{-2(r-\delta)} - 1}{2(r-\delta)}, \text{ (periodic adjustment to volatility)}$$

$$\sigma_A^2 = \sigma^2 A = \sigma^2 \frac{B_{-2(r-\delta)} - 1}{2(r-\delta)}, \text{ and (periodic adjusted volatility)}$$

$$d_n = \frac{S_t B_{-(r-\delta)} - X}{\sigma_A}. \text{ (quasi "z" score)}$$

13

13

## Summary

- Performance of 7 strategies, 3 variables simulated, and 3 different strike prices
- Focus, for illustration, on correlation effects
  - Stock returns and volatility (high influence)
  - Stock returns and interest rates
  - Volatility and interest rates



14

14