WI3421TU
Risicomanagement
Huiswerk 4

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12.17

(a)

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B: NASDAQ

C1: Asset Value: 10,000,000
C: Scenario Loss: =$C$1-B3/B2*$C$1
```

Sort Column C. The 15th worst loss is \$574,073.

So the 99% VaR using this method is \$574,073.

(b)

```
B: NASDAQ

C1: Asset Value: 10,000,000
C: Scenario Loss: =$C$1-B3/B2*$C$1

E: Exponential Weight: =0.955^(row()-1)*0.005/(1-0.995^1500)
```

Sort by C, keep going until the sum of E is equal to 0.01.

This happens for the first time at a loss of \$198,695.

So the 99% VaR using this exponential weighting is \$198,695.

(c)

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B: NASDAQ

F1: Asset Value: 10,000,000
C: Returns: =LN(B2/B1)
D: EWMA Variance: =0.94*D2+0.06*C1^2
D1501: Starting EWMA Variance: =VAR(C1:C1500)
E: Weighted Scenario Loss: =$F$1-$F$1*(B1+(B2-B1)*SQRT($D$1)/SQRT(D1))/B1
```

Sort by E, then find the 15th worst loss. This turns out to be equal to $157,767.

So the 99% VaR using this volatility-updating procedure is equal to $157,767.

(e)

Under the assumption that the daily returns have an $N(\mu, \sigma^2)$ distribution:

The sample average of the daily returns is 0.00069.

The sample standard deviation of the daily percent returns is equal to 0.020044.

Because $N(-2.33) = 0.01$, there is a 99% chance the daily return will not be more than 2.33 standard deviations lower than the average. That is, lower than -0.04601. With an asset value of 10 million, this gives us a 99% VaR of $460,125.

The EWMA approach as outlined in (c) gives an estimate for the standard deviation of the dialy returns today of 0.007554. Using the same approach, we can calculate a 99% VaR of $169,108.

The differences in these VaRs are all caused by the different weightings to data. Because volatility has been low recently compared to past years, the approaches using time-based weighting indicate a much lower VaR than the approaches that use time-independent weights.

13.17

From (13.5) we know that:

$$\begin{aligned} \Delta P &= S\delta\Delta x \\ &= 120\Delta x \end{aligned}$$

The standard deviation of ΔP is $120 * 0.02 = 2.4$.

Because $N(-1.65) = 0.05$, the 95% VaR can be estimated as $1.65 * 2.4 = 3.96$ USD.

13.18

From (13.7):

$$\Delta P = S\delta\Delta x + \frac{1}{2}S^2\gamma(\Delta x)^2$$

(a)

$$
\begin{aligned}
E[\Delta P] &= E\left[S\delta\Delta x + \frac{1}{2}S^2\gamma(\Delta x)^2\right]\\
E[(\Delta P)^2] &= E\left[S^2\delta^2(\Delta x)^2 + S^3\delta\gamma(\Delta x)^3 + \frac{1}{4}S^4\gamma^2(\Delta x)^4\right]\\
E[(\Delta P)^2] &= E\left[S^4\delta^4(\Delta x)^4 + 2S^5\delta^3\gamma(\Delta x)^5 + \frac{5}{4}S^6\delta^2\gamma^2(\Delta x)^6 + \frac{1}{2}S^7\gamma^3\delta(\Delta x)^7 + \frac{1}{16}S^8\gamma^4(\Delta x)^4\right]
\end{aligned}
$$

Assuming Δx is distributed as $N(0, \sigma^2)$, this becomes:

$$
\begin{aligned}
E[\Delta P] &= \frac{1}{2}S^2\gamma\sigma^2\\
E[(\Delta P)^2] &= S^2\delta^2\sigma^2 + \frac{3}{4}S^4\gamma^2\sigma^4\\
E[(\Delta P)^3] &= \frac{9}{2}S^4\delta^2\gamma\sigma^4 + \frac{15}{8}S^6\gamma^3\sigma^6
\end{aligned}
$$

(b)

$$
\begin{aligned}
\text{var}(\Delta P) &= E[(\Delta P)^2] - (E[\Delta P])^2\\
&= 10^2 * 12^2 * 0.02^2 + \frac{3}{4}10^4(-2.6)^2 0.02^4 - \frac{1}{4}10^4(-2.6)^2 0.02^4\\
&= 10^2 * 12^2 * 0.02^2 + \frac{2}{4}10^4(-2.6)^2 0.02^4\\
&= 5.765
\end{aligned}
$$

Because $N(-1.65) = 0.05$, the 95% VaR can be estimated as $1.65 * \sqrt{5.765} = 3.962$ USD.

14.22

Taking a $100 bond, the present value of the asset swap payments is $2.799.

Time	Probability	Recovery	Default-free	Loss	Discount	PV of Ex.Loss
0.5	Q	45	110.47	65.47	0.9802	64.17Q
1.0	Q	45	109.13	64.13	0.9608	61.61Q
1.5	Q	45	107.77	62.77	0.9418	59.11Q
2.0	Q	45	106.37	61.37	0.9231	56.65Q
2.5	Q	45	104.95	59.95	0.9048	54.24Q
3.0	Q	45	103.50	58.50	0.8870	51.89Q

Total PV of expected loss: 347.67Q

This must be equal to what we pay fo the asset swap spread:

$$347.67Q = 2.799$$
$$Q = 0.81\%$$

15.14

(a)

The value of the european call without the chance for a default (calculated using matlab / Black-Scholes) is \$6.20.

(b)

The value of an option is equal to its discounted expected payoff, so since there is only one possible default time, and no recovery, we can identify two possibilities:

A 0.98 chance of a payoff with an expected value that discounts to \$6.20, and a 0.02 chance of a 0 payoff.

This makes the expected value of the discounted option payoff equal to $6.20 * 0.98 + 0.02 * 0 = 6.076$.

The option with default risk is thus valued at \$6.076.

(c)

The discounted cost of default without the delayed payment is $6.20 - 6.076 = 0.124$.

The two cases with the delayed payment are:

A 0.98 chance of a payoff with an expected value that discounts to \$6.20.

A 0.02 chance of getting back the forward value of the option price. The discounted value of the forward value of something is the original value, as the operations cancel each other out, so the discounted payoff here is \$6.20.

Essentially, the cost of default for the buyer is reduced to 0, because the expected payoff is identical regardless of whether a default occurs.

(d)

The seller has a discounted cost of default of $0.01 * 6.20 = 0.062$. That means the option is worth that much more to them (being the seller).

To the seller, the extra risk means they will require a higher payoff, so the option is worth \$6.262 to them.

To the buyer, there is no more risk, so the option is worth the same value that it would be without a possibility for a default, that is, \$6.20.

The side taking the risk will want a higher price. Essentially, the buyer will be borrowing the value of the option from the seller, so as with any loan they will have to pay more depending on their chance to default.