Math GR 5320: Financial Risk Management and Regulation

Assignment 7

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Due next Thursday by 1:00 pm.

For help. the preferred approach is to post questions on the Q&A tab in Piazza:

https://piazza.com/columbia/fall2016/mathg5320_001_2016_3/home

These will be quickly responded to and will be helpful to others in the class.

Otherwise, attend TA office hours, email a TA or the professor, or schedule a meeting.

1. **Merton**

   Assume a Merton model for default with a constant risk free rate of r and an initial firm value of \$1,000,000. The firm issued a zero coupon bond with face value B that matures at time T:

$$\begin{aligned} dV &= \mu V dt + \sigma V dW \\ \mu &= 0.1 \\ \sigma &= 0.2 \\ r &= .05 \\ V_0 &= 1,000,000 \\ T &= 5 \\ B &= 700,000 \end{aligned}$$

   (a) What is the probability that the firm will default within 5 years?

   (b) What is the probability that the firm will default in between 3 and 4 years?

2. **Historical VaR, relative changes**

   Continuing with the settings in the previous homeworks, namely A being AMD, I being INTC, and P being the portfolio consisting of 620 shares of AMD, and 546 shares of INTC.

   Compute the 99% 5 day historical VaR and the 97.5% 5 day historical ES for A, I, and P for each day in the last 20 years. Do this for each date d by applying the previous 5 years of daily log returns to the position on that date.

   How do the historical VaR and ES compare to the previous results?

   Would it matter if the VaR for P was computed from the historical time series changes for P or from the historical time series changes for A and I applied to the underlying stocks in the portfolio? Why or why not?

3. **Historical VaR, absolute changes**

   Repeat the previous problem applying absolute changes instead of log changes. How do the VaR and ES change? In this case, would it matter if the calculation for P is done using the historical changes for P or using the historical changes for A and I applied to the underlying stocks in the portfolio? Why or why not?