Math GR 5320: Financial Risk Management and Regulation

Assignment 10

Department of Mathematics
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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. **Capital**

   For each type of position at a bank, tell whether it's an asset or a liability.

   (a) Cash

   (b) Savings accounts

   (c) Long bond positions

   (d) Loans from another bank

   (e) Mortgages made by the bank

   (f) Long position in mortgage backed securities

   (g) Office leases

   (h) Payroll

2. **Risk weighted assets**

   A bank has the following assets and liabilities:

   - 100,000 in cash
   - 50,000 in residential mortgages
   - 50,000 in corporate bonds
   - 195,000 in deposits

   Given risk weights of:

   - 0% – Home country sovereign debt
   - 10% – Certain public debt
   - 20% – Interbank loans
   - 50% – Residential mortgages
   - 100% – Private sector debt

   (a) What are the assets and liabilities?

   (b) What is the capital?

   (c) What are the risk weighted assets?

   (d) What is the capital ratio?

   (e) What is the leverage ratio?

3. **Option portfolio VaR**

A portfolio consists of a $10,000,000 position in the S&P. Risk management says that the 99% 5 day VaR has to be reduced by 20%. Instead of liquidating 20% of the portfolio to do this, the portfolio manager would like to liquidate a portion of the portfolio and use the money to buy 1 year maturity ATM puts to bring his VaR down the required amount.

Use the data from the spreadsheet `hw10.csv`, which contains approximately the last 10 years of S&P prices and the corresponding implied volatilities for at the money 1 year puts. The spreadsheet was generated by `hw10.xls`, which downloaded the data from the Bloomberg. Assume the implied volatility surface is flat (i.e. that all options on the S&P on a given date trade at the same implied volatility, regardless of strike and maturity).

Assume the 1 year risk free rate is 0.5%.

Assume the only risk factor is the stock price (i.e. – ignore implied volatility risk).

(a) What are the GBM parameters and the current VaR of the portfolio (on 11/4/2016)?

(b) What is the VaR of the portfolio if 1% is liquidated and used to buy at the money 1 year maturity puts?

(c) What percentage of the portfolio should be liquidated to purchase ATM 1 year puts so as to reduce the portfolio VaR by 20%?

(d) How would the results change if volatility risk were taken into account?