**MFE SPRING 2016 – MGMT 237I – Dr. Ehud Peleg**

**Sample Final**

**Name\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ UID\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**

There are 4 questions. You have 3 hours to answer all of them.

The exam is open book, and you may use your computers and the Internet.

You are not allowed to copy, discuss or share your answers with anyone during the exam!!

1. US Bank has a portfolio of $10B in loans and bonds. Assume that every asset is small compared to the total portfolio. 25% of the portfolio are in AA-rated assets, which have 0.05% Probability of Default (PD); 70% are in A-rated assets which have PD=0.10%; and 5% are in BBB-rated assets which have PD=0.30%.

1. Suppose the recovery on the loans given default is 45%. Use the closed-form Normal Copula formula, and Gordy’s result to find the 99.9% Unexpected Loss Credit VaR of the portfolio. Assume the Normal Copula correlation is 0.23.
2. Suppose US Bank bought protection from JP Morgan for the portfolio over the next year. US Bank will assume the first $40M in losses over the year. If there are losses greater than $40M, JP Morgan will compensate US Bank for any losses above $40M. What is the probability that JP Morgan will have to pay anything to US Bank?
3. To account for lower loan recoveries in economic downturns, JP Morgan decides to adjust the Single Factor Default-Only Normal Copula simulation by making Loss Given Default a function of *F*, the single factor.

Instead of LGD=55%, for every loan that defaults, LGD is applied according to:

*NewLGD = (Φ(-F)+0.55)/2*

where *Φ* is the standard normal c.d.f.

Suggest a closed-form modification to the closed-form formula for VaR99.9%:

that will yield similar results as such a simulation, for a portfolio of relatively small loans. (No actual simulation is required.)

2. A firm has an outstanding 3-year bond with annual coupons of 4%. The continuously compounded yield on the bond is 5%. The continuously compounded risk free rate for all maturities is 2%. The recovery rate on the bond is 40% of face value. If the firm defaults in a given year, it does so at the middle of the year.

* 1. Compute the present value of expected losses due to default.
  2. Suppose the unconditional probability of default is the same for all 3 years. What is the unconditional probability of default?
  3. The firm has a more senior zero coupon obligation of $100 due in three years. If the firm defaults, recovery on the senior obligation will be 60% of its market value. What should be the price of the obligation? What is its yield and credit spread?

3. A rating agency would like to set a scale for rating companies based on their Debt/EBITDA ratio. For that purpose, it applies the Linear Discriminant Analysis to a sample of 100 firms. Out of these firms, 25 firms defaulted while 75 did not. The average Debt/EBITDA ratio for the defaulted firms was 9, while the average ratio for the non-defaulted firms was 2. The variance of Debt/EBITDA ratios in the sample was 4.

The rating agency would like to classify as BBB firms that have at least 0.1% chance of default, but less than 0.5% chance. Under the Linear Discriminant Analysis assumptions, what range of Debt/EBITDA ratios should they set for BBB firms?

4. A bond investor is long $5,000 Notional of the 1-year zero coupon bond and $1,000 Notional the 10-year zero coupon bond. He is short $4,000 Notional of the 5-year zero coupon bond. Interest rates are 5% continuously compounded for all maturities.

1. What is the duration of the portfolio?
2. Estimate the percent change in the value of the portfolio due to an increase of 0.1% in yields using the duration approximation.
3. Compute the 1-year, 5-year and 10-year partial duration of the portfolio. Compute the dollar change in portfolio value for 1bp change in each zero-rate.
4. The loadings of the 3 main principal factors on the 1-, 5-, and 10-year bonds, and the standard deviation of their scores are given below. Compute the dollar change in portfolio value for 1bp change in each principal factor. Quantify the relative importance of the three factors for this portfolio.

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| --- | --- | --- | --- |
|  | PC1 | PC2 | PC3 |
| 1 year | 0.216 | -0.501 | 0.627 |
| 5 year | 0.404 | 0.019 | -0.355 |
| 10 year | 0.376 | 0.371 | 0.068 |
| Standard Deviation | 17.55 | 4.77 | 2.08 |

1. Use the delta method using the 3 main principal components to figure out VaR99% of the portfolio.