Instructions for computer exercise 3

Purpose Implementing the Merton model is pretty easy but you have to make a lot of more or less arbitrary choices when estimating the model. The purpose of the exercise is to investigate how sensitive the probability of default (PD) is to these choices. You can use my function mymerton, or if you like numerical optimization you can write your own function (writing your own function is not needed for full credits).

Data The data are in the Excel files DataLab3accounting.xlsx, DataLab3prices.xlsx and DataLab3rf.xlsx in Canvas. The data is identical to the data used in the lecture on the merton model. For the accounting data CUSIP is a firm identifier from Compustat, LCT is total current liabilities, DLTT is long term debt, CSHO is number of shares, fyear is fiscal year. All amounts in MUSD. The firm is AAC Holdings. For the file DataLab3prices.xlsx Cusip is a firm identifier, Date is, well the date, and Prices is the close price of the stock. DataLab3rf.xlsx contains monthly 1-month T-bill expressed as annual interest rates (the zeros are correct and are not missing values).

Long and short term debt Merton assumes all debt has the same maturity but in practice the Merton model often works better if we care more about short term debt than long term debt. We can do this by calculating total debt K as $K = STD + kLTD$, $0 < k < 1$, STD is short term debt and LTD is long term debt. Show in a graph how the PD (one year ahead) varies for $k = 0.1, 0.2..., 0.9$. Use the full year of observations for calculating equity volatility and the risk free rate of return.

Time varying volatility Merton assumes that the equity volatility is constant but in practice we know that volatility varies over time. You should now investigate how sensitive PD is to different ways of estimating equity volatility. You can show the results in a table and/or in a graph. 1) Use the standard deviation of returns for the x most recent months with $x = 1, 3, 6, 9, 12$ so e.g. for x=1 use only the returns for december and for x=12 use all of the returns. Also use the average volatility from an EWMA model with $\lambda = 0.94$ (see code from Lecture 4) for estimating the volatility. Use the full year of returns for the EWMA model, also use the full year of observations for calculating the risk free rate and use $k = 0.5$ in $K = STD + kLTD$.

Extra not needed for full credit Combine the different choices of k for the different volatility estimates (skip EWMA) so that you use each method for estimating the volatility for each value of k. Present the results in a surface plot.

Answer the following short questions directly in the notebook

a. Which input is the Merton models most sensitive to?
b. Given the sensitivity, do you think the Merton model is a useful model for risk management?

Good luck!