MVE220/MSA400 Financial Risk 2018: Credit risk project

Instructions: The following assignment should be handed in before 17.00 on Thursday May 17th, 2018. Send the report to
`alexander.herbertsson@cff.gu.se` or `alexander.herbertsson@economics.gu.se`
and make a cc to the urkund adress `alexander.herbertsson.gu@analys.urkund.se`
If you do not send the report to the urkund adress, the project will not pass. If you write the report in word, then *do not convert the word-file into a pdf-file*, unless you use serious converting software. Insert page numbers on each page in your report.

Before you start with the project, please carefully read the "Student ethics" document on the webpage of the course, or on the link
`www.math.chalmers.se/Stat/Grundutb/CTH/mve220/1718/ethics2018.pdf`
and make sure that you understand the message in this document.

Please carefully read the corresponding parts in the lecture notes and the slides before you start with this assignment. Below all notation are defined as in the lecture notes and the slides. Carefully motivate and explain all terms, expressions and computations in your report. The most preferable program is matlab which also is the easiest tool for implementing this assignment. Insert your m-code in the report, either directly after each task, or in the appendix of the report, with clear references in each task where in the appendix the code can be found. Also send your computer files separately (zipped m-files) to `alexander.herbertsson@cff.gu.se` or `alexander.herbertsson@economics.gu.se`
You are of course encouraged to contact me when you have concrete questions, but first carefully read the lecture notes and the slides to see if your question have an immediate answer. You can also ask your questions regarding the project after the lectures.

Grading: In order to pass this project all tasks must be solved sufficiently good

Good luck!
Alexander

Task 1

Choose any type of homogeneous mixed binomial model, for any portfolio size m where the loans have identical size, and where the maturity for each loan is one year. Derive a formula for $\text{VaR}_\alpha(L)$ using the LPA approach. The formula can be explicit or semi-explicit. (You can of course use any of the mixed binomial models discussed in the lectures and notes or derive your own model).

Task 2

For the same model as in task 1, use e.g. matlab to compute the probability of having a portfolio credit loss in a certain interval by using the LPA-formula in your model for some

suitable chosen parameters and repeat this for different values of some of the parameters and/or loss-intervalls. Report your results in plots and/or tables and discuss your results.

Task 3

For the same model as in task 1 and 2, use e.g. matlab to compute the LPA-$\mathrm{VaR}_\alpha(L)$ and LPA-$\mathrm{ES}_\alpha(L)$ for your portfolio where $\alpha = 95\%, 99\%$ and 99.9%, for some suitable chosen parameters and repeat this for different values of some of the parameters. Report your results in plots and/or tables and discuss your results.

Task 4

Choose any mixed binomial model and use e.g. matlab to compute the LPA-$\mathrm{VaR}_\alpha(L)$ in your model for some suitable chosen parameters. With the same parameters, also compute the exact $\mathrm{VaR}_\alpha(L)$ in the same model via $\mathbb{P}[N_m = k]$, by using e.g. a while-loop. Compare your results of the LPA-$\mathrm{VaR}_\alpha(L)$ against the exact $\mathrm{VaR}_\alpha(L)$ (e.g. relative difference in percent). How will the difference depend on the portfolio size m? How will the difference depend on some of the parameters. Report your results in tables and/or plots and discuss your results.

Hint: Computing $\mathbb{P}[N_m = k]$ with the exact method can be numerically challenging for large m, so it is enough to make your studies for e.g. $m \leq 55$. If m is too small, the LPA-method will likely be a bad approximation, but this is something that you could investigate in your study in this task, along with other possibly sensitivity studies. Also note that in some models you might get an explicit formula for $\mathbb{P}[N_m = k]$ which can be useful in the numerical computations.

Task 5

Discuss how you would estimate the parameters in e.g. one of your chosen models, or, if you want, in some other mixed binomial model for portfolio credit risk. This discussion does not have to be supported with matlab-code and data. It is enough that you give a sensible motivation where it is clear that you have carefully thought your argument through, and preferably also supported these arguments with some probability and statistical theory.