**QF 430: Fall 2022**

Group Project

Please read this document completely, every sentence.

Group

Form a group of 4 students on Canvas. In Canvas, choose People from the menu on left, and then go to Project Groups to form your group. A group can have students from both sections of QF 430. You can be in exactly one group. **Please do not create new groups. Join one of the existing groups** which say "Project Groups". See the following screenshot from Canvas:
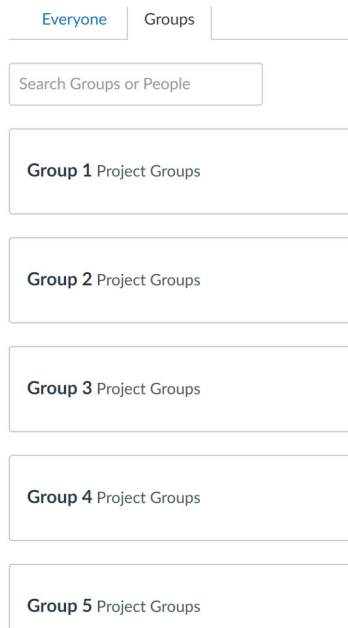

Due Date

Wednesday, November 30, 11:59PM

Description

You are a structuring a Collateralized Default Obligation (CDO) deal. There are 10,000 households, each with a mortgage loan of the same size. These are divided into groups of 100, each group's cash flows are used to find a separate Mortgage-Backed-Security (MBS). Each MBS has a senior, mezzanine, and an equity tranche. A schematic representation follows.
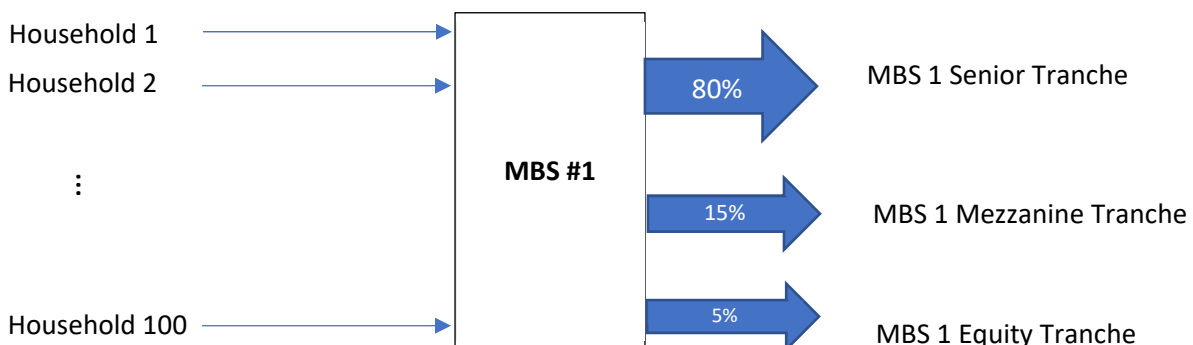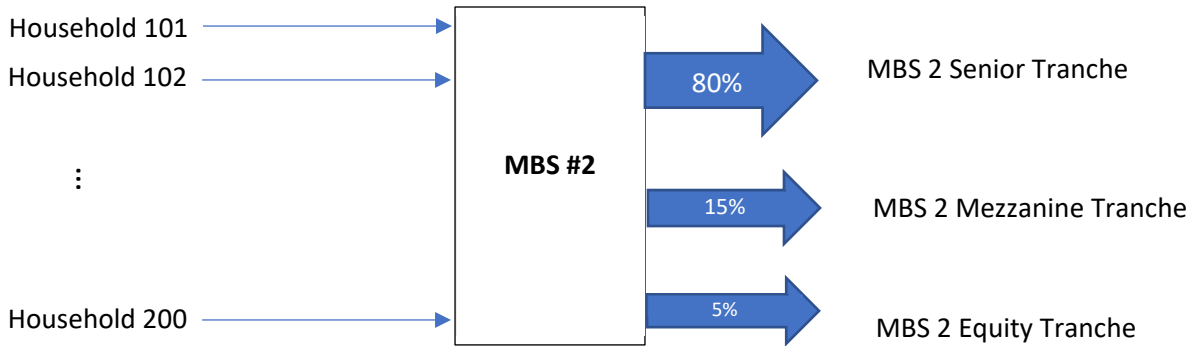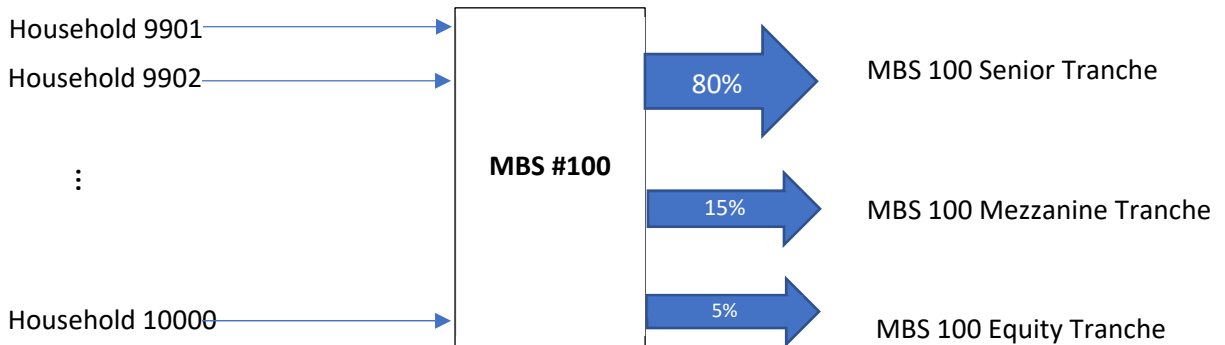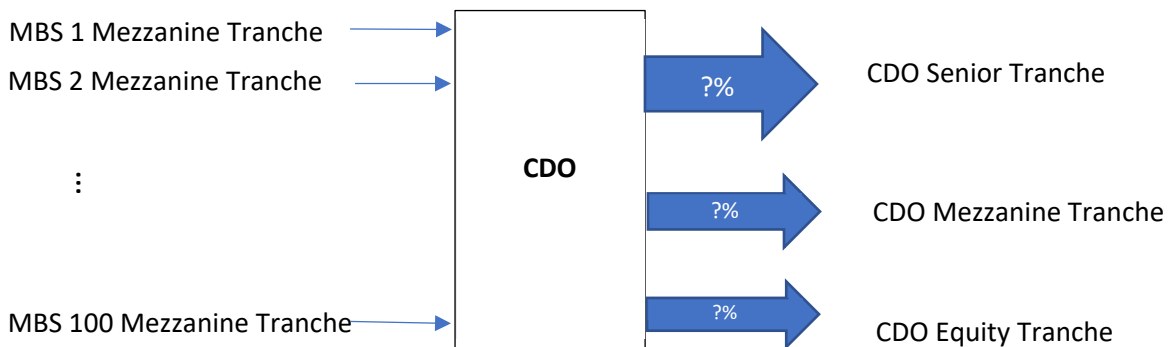
A CDO packages together Mezzanine tranches of the 100 MBS. Thus, the cash flow to CDO depends on loan payments from 100 × 100 = 10,000 loans.

All loans are of the same size (it does not matter whether this common loan amount is $1 or $100,000 or anything else). Assume that a loan has to make a single payment. Either the loan pays the loan amount in full or defaults. If the loan defaults, it still pays 40% of the loan amount.

The money received by an MBS is divided into three tranches. The percentage of cash flows promised to the three tranches of an MBS add up to 100%. Each MBS is structured so that Senior trancheholders are promised 80% of the total loan amount for the 100 loans backing the MBS. Mezzanine trancheholders are promised 15% of the total loan amount for the 100 loans backing the MBS. The total amount received from households backing an MBS equals the total loan amount only if none of the households defaults. If one or more households default, the amount received is less than the total loan amount.

The total amount received from the households backing an MBS enters the pool of the MBS and is paid out in a waterfall structure. The amount in the pool is used to first pay the promised payment to its Senior trancheholders. If the amount in the pool is insufficient to pay the promised payment to Senior trancheholders, Senior trancheholders receive the entire amount in the pool. Any amount left in the pool after paying senior trancheholders is used to pay the promised payment to the Mezzanine trancheholders of the MBS. If the amount left in the pool is insufficient to pay the promised payment to Mezzanine trancheholders, Mezzanine trancheholders receive the entire amount left in the pool. Finally, if any amount is left in the pool after paying Mezzanine trancheholders, it is used to pay Equity trancheholders of the MBS.

The payments made on Mezzanine tranches of all the MBSs are used to create the CDO you are structuring. The maximum amount that the CDO can receive is the sum of the payments to the Mezzanine tranches of 100 MBSs when each Mezzanine tranche receives its full promised payment (15% of loan amounts for 100 loans). When there are defaults, the CDO may receive less than the maximum amount. You have to determine the percentage of this maximum amount to promise to the Senior trancheholders of the CDO. Let us call this percentage the width of the Senior CDO tranche. You want this percentage to be high because Senior tranches can be sold for a high price. However, Senior trancheholders get their promised amount only when there is enough amount in the pool. Promising too much to the Senior trancheholders reduces the probability that they receive what they are promised. For the success of the deal, it is important that Senior trancheholders expect to receive their promised payment with 99% or higher probability.

The payment to the Senior trancheholders of the CDO depends on the number of defaults. You are provided a spreadsheet which lists loan outcomes (DEFAULT or PAID) for each of the 10,000 households. Based on these loan outcomes, calculate the total payment to each MBS, to each tranche of the MBS, the total payment to the CDO, and to the Senior tranche of the CDO. These amounts depend on the 10,000 loan outcomes. Of course, these loan outcomes are uncertain and may change so any possible combination of loan outcomes reflects just one of the many possible scenarios. Each time you refresh the spreadsheet, you get another scenario of 10,000 loan outcomes (and resulting payments to different tranches).

Your task it to simulate a large number of scenarios to accurately estimate the probability that the Senior trancheholders get their promised payment in full. And then you should adjust the width of the Senior CDO tranche and recalculate the probability. You should continue this process until the probability that the Senior trancheholders get their promised payment is 99%. It is difficult to get the exact probability through simulation so **your results must satisfy the following two conditions**:

1. The standard error of this probability should not be more than 0.2%.
2. 99% must lie between mean - standard error and mean + standard error.

The spreadsheet "Group Project 1 Template.xls" has a macro built in that will facilitate recording what happens across a large number of trials. You can modify this spreadsheet or preferably make a copy and modify that. Carefully read the instructions in the "Read Me" worksheet. Start by writing the first names of the group members in cells A1 to A4. This changes the spreadsheet a little. A few formulae are provided for the cash flows of the first MBS. You can change these and write other formulae for your calculations. To test the spreadsheet, lower the number of trials/iterations in cell N3 before you run the simulation. When you are confident, you can increase the number of trials. Finally, you don't need to use the macro in the spreadsheet if you prefer some other way of solving this problem.

Reference

1. Chapter 8 of Textbook
2. CDO Example spreadsheet on Canvas

Deliverables

1. A one page (no more) document with the following:
   a. Names of group members
   b. Width of the Senior CDO tranche as determined by you
   c. The expected cash flow to the CDO (not to the Senior tranche) as a percentage of the maximum possible payment to the CDO
   d. Your approach in brief (yes, it will probably be based on what is in this document, but use your words)
   e. Optional: any comments or problems you faced
2. The Excel spreadsheet with the results of your simulation (or any other file you used to solve the problem)

The document should preferably be a pdf but a text file or a Word document is also acceptable. Both files should be uploaded to Canvas with just one submission per group. Check your uploaded files to make sure you turned in the correct files.

Checklist for Submission:

1. Are you submitting a one-page document?
2. Are you submitting a spreadsheet?
3. Does your document answer parts a, b, c, and d above?
4. Are your first names listed in **cells A1 to A4** of spreadsheet?
5. Can your spreadsheet be used to verify your answers (width of CDO tranche, standard error of 0.2% or less, 99% in the interval mean – SE and mean + SE of probability that CEO senior trancheholders are paid in full, expected cash flow to the CDO)?