

Banking is complex. But, in a very simplified form, it reduces to “borrow money from those who want to invest them at interest, and lend the money to those who want to borrow them at interest“.

The money the bank borrowed is its “liability” (e.g., a deposit of 100 RUB for 6 months at 10% per annum), and the money the bank lent someone is its “asset” (e.g., a loan of 100 RUB for 1 year at 20% per annum).

If a bank has only these deposit and loan and plans to attract another deposit with the same parameters in 6 months, it seems like the bank should make a 10 RUB profit: the loan will bring the bank (100 RUB)\*(0.2 1/year)\*(1 year)=20 RUB, and the interest on the deposits will consume 2\*(100 RUB)\*(0.1 1/year)\*(0.5 year)=10 RUB. In 6 months, the bank has to attract the second deposit in order to pay the first one off. But by that time, the deposit interest rates may increase, decreasing the bank’s profit or even turning it into a loss.

Banks ensure their paying capacity with own capital. The regulator (the Central Bank of Russia) requires the banks to have own capital not less than a certain fraction of their risk-weighted assets (RWA) and controls calculation of RWA. The banks are interested in minimizing the own capital, and so they try to decrease their RWA estimates.

There are various mathematical models that estimate RWA for a given portfolio of assets and liabilities. The current model by the Central Bank of Russia is based on two principles:

1. If an asset and a liability are close both in period (the difference is no more than 30 days) and in interest rate (the difference is no more than 0.15% per annum) then only the difference of their amounts goes to RWA.
For example, if such asset and liability both amount to 100 RUB then the pair does not contribute to RWA (i.e., they “collapse” or, as the banking slang goes, they “net out”); and if the asset amounts to 300 RUB and the liability is 100 RUB then only 200 RUB of “residual asset” goes to RWA (this is “partial netting”).
A group of contracts (assets and/or liabilities) that can partially or fully net out with each other is called “netting set”. Let the sum of assets in it be , and the sum of liabilities be . Then the set sends to RWA either a “residual asset” (if ), or a “residual liability” (если ).
2. RWA is calculated on the “unneted” (residual) assets and liabilities using the formula
where the coefficients and are defined for each period group of assets and liabilities:

|  |  |  |
| --- | --- | --- |
| Period group |  |  |
| under 1 month | 0.05 | 0.2 |
| from 1 to 3 months | 0.1 | 0.4 |

You are provided with two datasets on the portfolios of assets and liabilities:

1. Portfolio of contracts for the period of under 12 month (files “Data\_Mammoth\_1month.xlsx” or “Data\_Mammoth\_1month.csv”): 1015 contracts without expiration dates,
2. Portfolio of contracts for the period of 1-3 months (files “Data\_Mammoth\_3months.xlsx” or “Data\_Mammoth\_3months.csv”): 2175 contracts with expiration dates.

**Task:** Partition the provided portfolio of contracts into correct “netting sets” that minimize the RWA value (i.e., from possible partitions you should choose the one that minimizes RWA).
The result should be submitted in the form of filling the “[ANSWER] Group number” column with numbers of groups for all contracts in the portfolio; and in the submitted paper you should indicate the reached RWA value and describe the algorithm that you used to partition the portfolio into “netting sets”.

**Tier 1)** Partition the “period under 1 month” portfolio into “netting sets”.
In this case, the correctness of grouping is determined only by the difference of interest rates inside the “netting sets”.

**Tier 2)** Partition the “period 1-3 month” portfolio into “netting sets”.
In this case, the correctness of grouping is determined both by the difference of interest rates and by the difference of periods of contracts.

The reached RWA value will be taken into consideration in scoring your work, but it will not be the only criterion. The submitted partitions will be checked for correctness, and the reached RWA value will be verified. For this reason, the Jury asks the participants to retain the format of the data files unchanged, and only fill your answers in and send them back bundled with the text of your paper.

If your partitioning method is computationally effective on big portfolios (e.g., tens or hundreds of thousands of contracts), it will count in as an additional advantage of your work.

**An example** of correct partitioning into “netting sets” is provided in the “Data\_Mammoth\_3months.xlsx” (“Data\_Mammoth\_3months.csv”) file in the “Example grouping (first 20 contracts)” column. It describes the partitioning of 20 contracts into 5 sets: set No.1 comprises 7 contracts, set No.2 comprises 10 contracts, and sets No.3,4, and 5 consist of one contract each. The reached RWA value is RWA=383300000 (the coefficients and are taken for the “1-3 months” time-frame).

**Note 1.** If you have solved the Tier 2’s problem, then solving Tier 1 is not necessary.

**Note 2.** The date format is “DD.MM.YYYY” everywhere. In the CSV files, the field-separator is “;” (semicolon), and the decimal digit is “.” (dot). In the Tier 2 data, there are precalculated periods of the contracts, measured in days (the “start date” is 22.03.2018).

**Note 3.** The final partitioning should be submitted either in the XLS/XLSX file, or in the CSV file. The is no need to put the answer into both formats.