Fixed-Income Security Trade Allocation

by derekmok

A *portfolio* is a grouping of financial assets, such as stocks, bonds, or *fixed-income securities*. Each portfolio is managed by a *Portfolio Manager* who is in charge of sending portfolio orders to a *Trader*.

A *Trader* receives orders of varying sizes from different portfolios to buy a quantity of a *security* on the market. They then identify a *Seller* that is willing to sell units of the desired security.

In a best-case scenario, the *Seller* is selling enough of the security to fulfill all of the portfolio orders for the security; however, if that is not the case, the *Trader* must buy as much of the security as possible and *fairly allocate it amongst the portfolios*.

Fixed-Income Security

A fixed-income security has the following properties:

- $\boldsymbol{minimum\_trade\_size}$ - The smallest number of units that can be traded with this security.
- $\boldsymbol{increment}$ - The number of units the trade can be incremented with.
- $\boldsymbol{tradeable\_amount} = (\boldsymbol{minimum\_trade\_size}) + (\boldsymbol{increment} \times n)$, where n is a non-negative integer.
- $\boldsymbol{avaliable\_units}$ - The number of units of the security that are available for purchase on the market.

Fixed-Income Trade Orders

A fixed-income *Trader* has the following information:

- $\boldsymbol{portfolio\_order}$ - The number of units of the fixed-income security that a single portfolio wants to buy.
- $\boldsymbol{total\_order}$ - The total (sum) number of units made up of all the underlying $\boldsymbol{portfolio_order}$s.

Defining a Proportional Allocation

If there are not enough $\boldsymbol{avaliable\_units}$ to fulfill all of the portfolio orders, we must find the proportional allocation for each portfolio's order of the $\boldsymbol{available\_units}$ on the market.

We get a portfolio's $\boldsymbol{proportional\_allocation}$ with this expression:

$$\boldsymbol{proportional\_allocation} = \frac{\boldsymbol{portfolio\_order}}{\boldsymbol{total\_order}} \times \boldsymbol{available\_units}$$

How Do We Fairly Allocate Units?

- Iterate through every underlying $\boldsymbol{portfolio\_order}$ from smallest to largest (if two portfolios order the same number of units, then sort them lexicographically by ascending ID) and apply the following process:
    - If the portfolio's $\boldsymbol{proportional\_allocation}$ is less than the $\boldsymbol{minimum\_trade\_size}$, check if $\boldsymbol{proportional\_allocation}$ is greater than $\frac{\boldsymbol{minimum\_trade\_size}}{2}$.
        - If false, do not allocate anything.
        - If true, attempt to allocate the $\boldsymbol{minimum\_trade\_size}$ within the defined rules.
            - If this fails; allocate nothing.

- If the portfolio's ***proportional_allocation*** is greater than or equal to ***minimum_trade_size***:
  - If the ***proportional_allocation*** is larger than or equal to the ***portfolio_order***, allocate the ***portfolio_order***.
  - If the ***proportional_allocation*** *is not* a ***tradeable_amount***, *round it down* to the closest ***tradeable_amount*** that you can allocate within the defined rules. If you fail to find a ***tradeable_amount*** that satisfies the rules, allocate nothing.
- After allocating units (including the case when you allocate nothing) to a portfolio, perform the following steps to ensure that as much of the available security is purchased as is possible:
  - Recalculate the ***total_order*** based on the orders from the remaining portfolios (i.e., those whose orders haven't yet been allocated).
  - Subtract the quantity of units that were just allocated to an order and recalculate ***avaliable_units***.
  - Recalculate the ***proportional_allocation*** of each portfolio awaiting allocation based on the remaining ***avaliable_units***.

Rules That Always Hold

- A portfolio manager *only* orders tradeable amounts from the *Trader*.
- Each portfolio has to issue its own trade, hence *the quantity allocated to each portfolio must be a* ***tradeable_amount***.
- An *untradeable amount* is a value that cannot be represented as a *tradeable amount*. Note that an exception of 0 is allowed (meaning that 0 is a tradeable amount). You must try to never leave a portfolio with leftover units ($portfolio\_order - allocated\_amount$) that can't be traded on the market (i.e., an untradeable amount).

Given the basic information for a fixed-income security and a list of portfolio orders, find the ***proportional_allocation*** for each portfolio using the rules and processes defined above. Then, print each ***portfolio_identifier*** along with the amount of the security allocated to it as two space-separated values on a new line. Order your output alphabetically by ***portfolio_identifier***.

Input Format

The first line contains an integer, T, denoting the number of portfolios hoping to place orders.
The second line contains three space-separated integers denoting the respective values for the ***minimum_trade_size***, ***increment***, and ***available_units*** for the fixed-income security.
Each of the T subsequent lines defines a portfolio order as two space-separated values; the first value is a string denoting the ***portfolio_identifier***, and the second value is an integer denoting the ***portfolio_order***.

Constraints

- $0 < T < 1000$
- $0 < increment < minimum\_trade\_size < available\_units$
- $portfolio\_order = minimum\_trade\_size + increment \times n$ for some non-negative integer, n.
- $minimum\_trade\_size \times number\ of\ portfolios < available\_units$

Output Format

Print T lines where each line contains two space-separated values: a ***portfolio_identifier*** followed by the number of units allocated to the portfolio. Your output must be ordered alphabetically by ***portfolio_identifier***.

Sample Input

```
2
10 2 40
p1 16
p2 134
```

Sample Output

```
p1 0
p2 40
```

Explanation

First, we have the following information about our fixed-income security:

- $minimum\_trade\_size = 10$
- $increment = 2$
- $available\_units = 40$

Next, we have $T = 2$ portfolio orders:

1. $p1$'s $portfolio\_order = 16$.
2. $p2$'s $portfolio\_order = 134$.

We can calculate $total\_order = 16 + 134 = 150$

$$p1\_proportional\_allocation = \frac{16}{16 + 134} \times 40 = 4.26$$

Because $p1\_proportional\_allocation < \frac{minimum\_trade\_size}{2} \implies 4.26 < 5$, nothing is allocated to $p1$. Therefore, all 40 $available\_units$ are allocated to $p2$.

Submissions: 179

Max Score: 20

Difficulty: Moderate

More

Current Buffer (saved locally, editable) Java 7

```
1  import java.io.*;
2  import java.util.*;
3  import java.text.*;
4  import java.math.*;
5  import java.util.regex.*;
6
7  public class Solution {
8
9      public static void main(String[] args) {
10         /* Enter your code here. Read input from STDIN. Print output to STDOUT. Your class should be named
   Solution. */
11     }
12 }
```

Line: 1 Col: 1

Upload Code as File Test against custom input Run Code Submit Code