

Problem B

Budget Analysis

You are an analyst, studying the relationship between advertisement budget spending (denoted by x) and sales (denoted by y) over the period of n months. More specifically, for every month of time from 1 to n you have the value of spending x_i and sales y_i .

To quantify the relationship you are using linear regression with regularisation, which means that you are modelling y as $y = Kx + B$, where K and B are real numbers minimising the penalty function:

$$p(K, B) = \sum ((K \cdot x_i + B - y_i)^2) + \lambda \cdot (K^2 + B^2)$$

(Note: this is the standard penalty function for L2 regularised linear regression.)

For the report requested by your manager, you need to make several predictions. More specifically, you have a list of prediction queries, each described by four numbers — L_j , R_j , λ_j and X_j . To process such a query you need to perform the following steps:

- take the spending and sales values for the months from L_j to R_j inclusive;
- find the coefficients K and B , which minimise the penalty function for the given regularisation coefficient λ_j ;
- plug the X_j into the resulting model and compute the prediction.

You are given the ads spending and sales data, and the prediction queries descriptions. You are to process the queries and output the predictions.

Input

First line of the input file contains an integer number n ($2 \leq n \leq 10^6$) denoting the number of months in the period you are studying.

Each of the following n lines describes one month and contains two non-negative real numbers x_i and y_i not exceeding 10. They denote the budget spending and sales in the corresponding month.

The following line contains an integer number m ($1 \leq m \leq 10^6$) denoting the number of predictions to be made. Each of the following m lines contains four numbers: L_j , R_j , λ_j and X_j ($1 \leq L_j < R_j \leq n$, $0 \leq \lambda_j, X_j \leq 10$). First two of them are integers, the remaining are real.

Output

For each prediction query output one real number on a separate line — the predicted sales assuming the advertisement spending is X_j and the linear model has been fitted on months from L_j to R_j using L2-regularisation with λ_j regularisation coefficient. The output must be accurate to an absolute or relative error of at most 10^{-6} .

Sample Input 1

```
5
1 2
3 4
5 6
7 8
9 0
2
1 3 0 10
1 5 1 10
```

Sample Output 1

```
11
4.90566037735849125
```

Sample Input 2

```
3
1 1.0
2 2.1
3 2.8
3
1 2 0 1.5
2 3 0 2.5
1 3 0 1.5
```

Sample Output 2

```
1.55
2.45
1.5166666666666667
```