

COMP3121 Homework Q5

Arth Sanskar Patel
z5228942

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1 Answer

This is a loss minimisation problem. Here we have W_i as the weight of a chemical C_i where $i \leq N$. p percent of chemical evaporates every day. We have to produce chemicals in such a order that the loss due to evaporation is minimised. The amount of chemical evaporated after a day is:

$$W_{evaporated} = W_i * (p)$$

similarly the weight left will be:

$$W_{left} = W_i * (1 - p)$$

Chemical C_i left after k days is:

$$W_{left} = W_i * (1 - p)^k$$

Similarly the amount lost after k days will be:

$$W_{lost} = W_i * (p)^k$$

Lets say that the delivery is scheduled after k days, then the amount we need to produce to be able to deliver W_i weight is W_{left} . Hence:

$$W_{production} = \frac{W_i}{(1 - p)^k}$$

Our task in this question is to minimise the amount lost. As $W_{lost} = W_i * (p)^k$, here p will be constant for every chemical C_i so the only factor minimising the loss for a given k will be the weight W_i . As $W_{lost} \propto W_i$, so reducing W_i will directly reduce our loss. So if we are reducing the loss on one chemical, The total loss will be reduced as it is simply the total of all the losses.

So lets sort the given chemicals to produce in order of their weights required. So we pick first chemical from the sorted list and produce $W_i / (1 - p)^{N-j-1}$. where j is the index of chemical picked. For example if we pick 4th chemical from the list then we have to produce $W_i / (1 - p)^{N-4}$ of that chemical in order to have W_i by the end of $N - 4$ which is the end of your production schedule and then we will deliver after that.

We know the answer is optimal because on each step we are minimising our loss. Clearly when a chemical C_i with weight $W_i > W_j$ of chemical C_j is produced before C_j , it will evaporate more and hence produce more loss. So selecting in order of weights will ensure that we minimise the loss as the heaviest chemicals will have less time to evaporate than lighter chemicals. This problem can be solved so easily because the percent p is same for all the chemicals be it heavy or light. The pseudo code for this is given below.

```
1  def class chemical:
2      chemicalName
3      chemicalWieght
4
5  orders = [C1, C2, .... Cn]
6
7  sortedList = sortIncreasing(orders)
8  # sortedList is in increasing order of weight of chemicals
9  percentEvaporated = p
10 percentRemain = 1 - p
11
12 for i in range(0, N)
13     produce((sortedList[i].chemicalWieght)/(percentRemain ** (N-i)))
```