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COMP3121 Assignment 3 – Question 5

5) We are required to schedule the production of the chemicals such that the total extra weight of the chemicals which we need to produce to compensate for the evaporation los is as small as possible. Additionally, it should be noted that all the chemicals are to be delivered on the same day that the last one is produced. We can produce as much of a chemical as we want on a given day, and produce just enough that by the day of delivery, after we have taken the evaporation $p\%$ that occurs on the amount at the end of the previous day into account, we have our required amount W_i kg for each chemical C_i. So our strategy needs to take into account the situation where we produce a chemical on day K, and make it last for N – K days (as we have N chemicals and we produce one chemical a day) making sure we have the required amount by day N (our delivery date). Our strategy also needs to take into the obvious situation where the more of a chemical we produce, the more that will be evaporated. Hence, we need to focus on scheduling the production of our chemicals in such a way that this outlay of chemicals will be minimised.

First, we need to determine how much of a chemical is left after one day. To do this, we should take the chemical with the least W_i required to be produced. Once we have this, we can determine our p% evaporation factor that occurs for the chemicals (as it is consistent across the board). From here, we can see how much of a chemical is required to be produced to have enough by the day of delivery.

Next, we need to sort our chemicals in order of increasing W_i. Once we have this sorted list, we can then determine the schedule of production of the chemicals where the least W_i chemical will be produced first and the largest W_i chemical will be produced on the day of delivery.

This solution will be the most optimal as once we have our list of increasing W_i, we can produce chemicals in that order. Let us say that we did not do this method. If we instead produced a chemical that had a larger W_i than another chemical, then the p% evaporation factor on that will result in a much larger loss than if we had instead produced the one with the smaller W_i. Additionally, once we produce a chemical, there is no need to produce more of the same chemical on another day (as we are assuming that the first time we produce a chemical is the only time we produce the chemical and that it will be enough such that by the day of delivery, our initial produced amount will end up being the required W_i).

In other words, suppose that we have N number of chemicals. On that particular day, we would choose the chemical with the least W_i, and so the amount that we would end up producing for that chemical is:

$$\frac{W_i}{(100\% - p\%)\hat{}(N-1)}$$

If we had instead chosen any other chemical with a greater W_i then it would have resulted in a greater loss of chemicals, as calculated by the above formula.

End of Solution