IMPLEMENTATION NOTES FOR LABS 1 AND 2

KYEREMANTENG, PRINCE SAMUEL

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TASK 1 – VACCINES

The objective of this task was to optimize the allocation of vaccines across regions to maximize coverage efficiency using dynamic programming approach.

The code implementation utilizes a bottom-up approach with a 2D DP table to track maximum coverage for given vaccine quantities across regions.

We maintained a decision table to trace back which regions received vaccines and how many. The pseudocode and the assumptions used are given below.

ALGORITHM IN PSEUDO-CODE

Define Region with attributes: name, population, risk, infra

Function optimize_vaccine_distribution(regions, total_vaccines):

Initialize dp and decision tables to store coverage values and allocation decisions

For each region:

For each possible vaccine count up to total_vaccines:

 # Option 1: Do not allocate vaccines to this region

Set current coverage value as previous region's value for this vaccine count

 # Option 2: Allocate vaccines to this region

For each possible allocation to the region:

Calculate coverage based on region's risk and infrastructure

Update dp and decision tables if this allocation improves coverage

Trace back through the decision table to determine final allocations

Return the maximum coverage and the allocation list for each region

ASSUMPTIONS AND CONSTRAINTS

- We assumed that each region's effectiveness in utilizing vaccines is proportional to the **risk * infra** factor, making the coverage value higher in regions with greater need.
- To ensure no wastage in allocation, we assumed that a region cannot receive more vaccines than its population size.
- Infrastructure is assumed to be a reliable measure of a region's capability to distribute vaccines efficiently.

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TASK 2 – SUPPLY CHAIN

The objective of this lab work was to develop a dynamic programming model to allocate vaccines efficiently across multiple regions with different population sizes, risk levels, and healthcare needs.

The code attached, implements a dynamic programming solution to optimize the distribution of medical supplies to clinics. It uses a bottom-up approach to maximize the efficiency of the supply chain.

ALGORITHM IN PSEUDO-CODE

Initialize dp table and decision table

For each clinic from 1 to n:

For each supply level from 1 to total_supplies:

Set dp[i][s] to the maximum value without supplying this clinic

For each possible supply allocation x to the clinic:

Calculate potential value if x supplies are allocated

If potential value is greater than current dp[i][s]:

Update dp[i][s] with potential value

Record decision in decision table

Trace back decisions to determine which clinics received supplies

Return the maximum efficiency value and list of supplied clinics

ASSUMPTIONS AND CONSTRAINTS:

In building this dp model, the following assumptions were made:

- We assumed that the clinics could receive partial supplies, not just the full demand.
- We assumed Distance as Efficiency. That is, the benefit of supplying a clinic is proportional to its distance, interpreted as a measure of logistical efficiency or importance.
- We assumed that supplies are allocated in discrete units (whole numbers).
- We ensured that the total number of supplies is limited.
- We ensured that each clinic has a specific demand that can be partially or fully met within and depending on the available supplies.
- We ensured that supplies allocated cannot exceed available supplies.