Assignment 6

1. K-Means Insights

- Compare:K-Means formed 3 clusters of countries on the basis of air, water, and soil pollution, and energy use.
- Different types of countries appeared in each cluster:
- Cluster 0: Countries with high pollution and very low energy recovery.
- Cluster 1: Countries with medium pollution and moderate energy recovery.
- Cluster 2: Countries with low pollution and high energy recovery.
- These clusters help in identifying countries that need immediate attention and which ones are doing well.
- The Elbow Method was chosen to decide that 3 clusters would be the best.
- This gives way to decisions made on groups rather than on each country individually.

2. The Hierarchical Clustering Insights

- Hierarchical clustering is a tree structure (known as a dendrogram) representing the similarities between countries.
- It uses "Ward's method", which tries to maintain groups with maximum homogeneity.
- From the dendrogram, we:
- Observe pollution-wise similarities between countries.
- Allow natural groups to emerge without specifying cluster numbers.
- This is particularly helpful for governments and researchers, who want to assess how pollution-wise close countries are.

3. Neural Network Accuracy

- The model is designed to predict the energy (in GWh) a given country can recover, depending upon variables like:
    - Air Pollution Index
    - Water Pollution Index
    - Soil Pollution Index
    - Industrial Waste
    - CO_2 Emissions
- Two layers were used by the model to learn patterns; this turned out well with good predictions.
- The model has been trained and tested on real data:
- It used Mean Squared Error (MSE) as the loss function.
- It gave good predictions to the amount of energy it recovers from pollution features.
- From this model, one can forecast the amount of recovery in the future to compare various countries' expected performance.

Overall:

Method	What it does	Good points	Bad points
K-Means	Groups countries into 3 based on pollution and energy use	Fast and simple	You must choose the number of groups (k)
Hierarchical Clustering	Shows a tree of how countries are similar	Gives a clear picture	Slower and harder to use for big data
Neural Network	Predicts how much energy a country recovers	Learns deep patterns	Needs more data and training

SOLUTION

For Countries in High-Pollution, Low-Energy Clusters:

- Build waste-to-energy plants
- Reduce industrial emissions and switch to cleaner fuels
- Promote public transport and reduce vehicle emissions
- Educate citizens about pollution and recycling

For Countries in Medium-Level Pollution Clusters:

- Focus on energy-efficient technology
- Start carbon tracking in industries
- Introduce tax benefits or incentives for clean businesses

For Low-Pollution, High-Recovery Countries:

- Continue current policies
- Invest in green energy R&D
- Share their successful strategies with other nations