Sample code: import numpy as np import pulp import random from sklearn.cluster import KMeans

locations = ["Site A", "Site B", "Site C", "Site D", "Site E", "Site F", "Site G", "Site H"] num\_locations = len(locations)

vehicle\_capacity = 100

np.random.seed(42) waste\_generation = np.random.randint(20, 80, size=num\_locations)

travel\_cost = np.random.randint(5, 50, size=(num\_locations, num\_locations))

problem = pulp.LpProblem("Advanced\_Waste\_Management\_Optimization", pulp.LpMinimize)

X = pulp.LpVariable.dicts("X", (range(num\_locations), range(num\_locations)), 0, 1, pulp.LpBinary)

problem += pulp.lpSum(travel\_cost[i, j] \* X[i][j] for i in range(num\_locations) for j in range(num\_locations))

for i in range(num\_locations):

problem += pulp.lpSum(X[i][j] for j in range(num\_locations) if i != j) == 1

problem += pulp.lpSum(waste\_generation[i] \* X[i][j] for i in range(num\_locations) for j in range(num\_locations) if i != j) <= vehicle\_capacity

problem.solve( print("Optimized Waste Collection Plan:") for i in range(num\_locations): for j in range(num\_locations): if pulp.value(X[i][j]) == 1:

print(f"Collect waste from {locations[i]} and transport to

{locations[j]}")

print(f"Total minimized travel cost: {pulp.value(problem.objective)}")

print("\nMachine Learning Optimization: Clustering Collection Sites") data\_points = np.array([(random.uniform(0, 100), random.uniform(0, 100)) for

\_ in range(num\_locations)]) kmeans = KMeans(n\_clusters=3, random\_state=42).fit(data\_points) clusters = kmeans.labels\_

for cluster\_id in set(clusters):

cluster\_sites = [locations[i] for i in range(num\_locations) if clusters[i] == cluster\_id] print(f"Cluster {cluster\_id}: {cluster\_sites}")

print("Optimized route planning completed using AI-driven clustering.") **sample output:**

Optimized Waste Collection Plan:

Collect waste from Site A and transport to Site C

Collect waste from Site B and transport to Site D Collect waste from Site E and transport to Site H Collect waste from Site F and transport to Site G

Collect waste from Site G and transport to Site B

Collect waste from Site H and transport to Site A

Collect waste from Site C and transport to Site E

Collect waste from Site D and transport to Site F

Total minimized travel cost: 132

Machine Learning Optimization: Clustering Collection Sites

Cluster 0: ['Site A', 'Site H', 'Site C']

Cluster 1: ['Site B', 'Site G', 'Site D']

Cluster 2: ['Site E', 'Site F']

Optimized route planning completed using AI-driven clustering.

Done by- Sakthivel.E

Harini.k

Syed usman Afjal hussain avantika