import networkx as nx  
import random  
import pandas as pd  
import shutil  
  
def generate\_large\_network(num\_nodes\_range, num\_edges\_range):  
 num\_nodes = random.randint(\*num\_nodes\_range)  
 num\_edges = random.randint(\*num\_edges\_range)  
  
 G = nx.gnm\_random\_graph(num\_nodes, num\_edges)  
  
 # Assign random weights (free flow travel time, capacity, and actual flow) to edges  
 for (u, v) in G.edges():  
 G.edges[u, v]['free\_flow\_time'] = round(random.uniform(5, 30), 2)  
 G.edges[u, v]['capacity'] = random.randint(100, 1000)  
 G.edges[u, v]['actual\_flow'] = random.randint(50, G.edges[u, v]['capacity'])  
  
 return G  
  
def export\_to\_excel(G, filename="network\_data.xlsx"):  
 data = []  
 for (u, v) in G.edges():  
 data.append({  
 "Edge": f"{u}-{v}",  
 "Free Flow Time": G.edges[u, v]['free\_flow\_time'],  
 "Capacity": G.edges[u, v]['capacity'],  
 "Actual Flow": G.edges[u, v]['actual\_flow']  
 })  
  
 df = pd.DataFrame(data)  
 df.to\_excel(filename, index=False)  
 return filename  
  
def generate\_multiple\_large\_networks(num\_instances, num\_nodes\_range, num\_edges\_range, base\_filename="large\_network\_data"):  
 filenames = []  
 for i in range(num\_instances):  
 G = generate\_large\_network(num\_nodes\_range, num\_edges\_range)  
 filename = f"{base\_filename}\_{i+1}.xlsx"  
 export\_to\_excel(G, filename)  
 filenames.append(filename)  
 return filenames  
  
# Generate 15 large network instances and export to Excel  
num\_instances = 20  
num\_nodes\_range = (40, 60)  
num\_edges\_range = (100, 200)  
large\_filenames = generate\_multiple\_large\_networks(num\_instances, num\_nodes\_range, num\_edges\_range)  
  
# Move the generated files to the appropriate directory for download  
for filename in large\_filenames:  
 shutil.move(filename, f"/mnt/data/{filename}")